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ELECTRICITY IN THE NAVY.

The introduction of the electric light in United States naval vessels dates from 1883, when a 150-light Edison dynamo was installed aboard the *Trenton*. Two years later a 100-light plant was placed in the *Omaha*, and as an indication of the progress during the following eighteen years, it is interesting to note that the horse-power of the electrical plant on the latest type of battleship is just equal to the maximum power developed by the propelling machinery of the *Omaha*. The ratio of electrical to propelling horse-power has since 1883 increased from less than ½ of 1 per cent. to 6 per cent. in the *Connecticut* class. Of late years the most interesting development in naval electrical engineering has been the growing use of electric motors. As will be seen in the article appearing elsewhere describing the electrical equipment of the *Connecticut* class, 192 motors for 21 different classes of service are installed, not including 59 fan motors ranging from 1/12 to ¼ horse-power. Every part of the electrical equipment for these vessels appears to be well selected and skillfully applied, with perhaps the exception of the engine and helm telegraphs, which are decidedly crude in design, though possibly satisfactory in service.

In view of the fact that in the design of a war vessel every ton of weight and every cubic foot of space subtracted from the propelling equipment, armament and armor, entails a sacrifice of fighting qualities, the advisability of a duplicate electrical generating equipment seems questionable. By one of those strange perversions occasionally found in military organization, electrical engineering in the navy does not come under one of the two naval engineering departments—those of Steam Engineering and Construction—but under a Bureau having otherwise no cognizance of matters bearing any relation to engineering. As a consequence of this bureaucratic situation, the electrical generating plant aboard ship is installed in compartments separate from those assigned to the main propelling machinery, and forms a department in charge of a separate staff. We venture to say that if the proposed plan of consolidating under one bureau everything relating to engineering is carried out, a place for the electrical generating plant will readily be found in the main machinery compartments, thus rendering available for other purposes the valuable space now occupied in two different portions of a vessel. If installed with the main machinery, the electrical generating plant could well be allowed to take its chances with the propelling machinery with respect to danger of disablement in battle, thus obviating complete duplicate plants and consequent sacrifice of weight and space.

As pointed out in the article here referred to, there is still further opportunity for the advantageous application of electric motors aboard warships. For example, there appears to be no reason whatever for holding to the steam engine for the operation of ash and anchor hoists and for steering. On the other hand, it is still a question whether it would be wise to substitute the electric motor for the steam engine for driving forced-draft fans and the main engine pumps. The former are rarely used and require considerable power, the demand for which in action would come when the maximum load was on the generating plant, thus involving a further increase in the size of the generating plant. The same would follow the substitution of electricity for steam for operating the main engine pumps; moreover, these latter are so near the steam supply

that one of the greatest advantages of the use of electric motors does not apply, while the danger of interruption of service would be increased by the interposition of the additional stages between the source and point of application of the power.

The Light and Power Industry.

Statistics from the United States Census Office were published in these pages last week giving a number of interesting details about the central station industry in the United States. A total of just over $500,000,000 was shown for the investment, with a yield of about 6 per cent. for the private companies, 2,804 in number. These figures follow closely upon those for street railways, for which 987 companies returned data, with a total "investment" of $2,308,000,000, or nearly five times the capital obligations of the lighting industry. It is, however, to be borne in mind that in street railway work there are no isolated plants; and thus far there are no municipal plants to bother about. Including isolated plants, the electric lighting industry in America is probably somewhere around the billion dollar mark, or to be more explicit, reaches $1,000,000,000. But even that figure is more than doubled by the trolley development, evidencing how heavy is the capitalization necessary for hauling all the people all the time. This larger capitalization hardly goes, however, into power plant, as the horse-power dynamo capacity for lighting is 1,615,480 horse-power, while that for street railway work is 1,204,238 horse-power. In other words, track and rolling stock would appear to represent a very large part of the difference between the two capital accounts.

The Earth as a Condenser.

In the Digest appears this week an abstract discussing the rôle of the earth in wireless telegraphy, in which two interesting points are brought into prominence. One of these is the small electrical capacity of the earth, and, therefore, the improbability of its playing any part, as has been suggested, in the transmission of large quantities of electrical energy by utilizing it as an element in a resonant circuit. The author calculates a special case, assuming conditions that might be approximated in practice—though a vertical conductor extending 2,700 yards in the air is scarcely a practical assumption; with resonance established, the maximum current rush would then not exceed 15 amperes, and the total flow of current would be only .0009 coulomb. An important conclusion of the investigation is, however, that in wireless telegraphy the capacity of the earth may be utilized to great advantage. If the premises of the author are correct, the conditions of resonance can be satisfactorily met without great difficulty by proper design of apparatus, in which case sending signals half around the earth could be as readily accomplished as sending them over short distances. In the past ideas relating to the earth as an electrical factor have been extremely vague, and not infrequently it has been assigned electrical properties solely to bolster up a personal speculation or to conceal limitation of knowledge. In resonance the earth can only enter as a capacity, and this determined, the limit of its rôle in any given case is subject to definite calculation. The line of study indicated is one which we hope will be continued by others.

Electric Conductivity of Selenium.

An interesting communication has recently been presented by M. Van Aubel to the French Academy of Sciences on the change in the electric conductivity of selenium effected in the presence of bodies treated with ozone. It is now more than twenty years since the discovery was made that selenium altered its resistance when exposed to ordinary daylight. Selenium enjoys a relatively high but fairly steady resistivity. An attempt was made to produce high-resistance prisms of selenium for industrial purposes as compact standard resistances. These were placed in a closed box after the fashion of ordinary wire resistance coils. It was discovered that when the lid of the box was withdrawn, so as to admit of adjusting the connections, the resistance of the selenium underwent marked change, and that the original resistance became practically restored after closing the box. In the present instance it appears that caoutchouc which had been subjected to a current of dry ozone for twelve minutes acted towards selenium like a feeble illuminant. When exposed to the ozonized caoutchouc the selenium resistance fell seven per cent. in fifteen minutes, and the original resistance was restored after the radiation from the caoutchouc was intercepted. A few years ago the world remained in blissful unconsciousness of the existence of radiations other than those of heat and light. Now the difficulty is to find a location which is not constantly permeated by all kinds of radiations and undulations other than those of ordinary light.

Coherers and Anticoherers.

A long paper by M. Hurmuzescu has recently appeared in *L'Eclairage Electrique*, in which the author reviews the history of this subject and describes experiments of his own made to elucidate some of its intricacies. When coherers are studied superficially, and in their simplest forms, their theory of action seems readily apparent. But when studied more deeply, and with a full regard to all the phenomena presented, the theory becomes very complex. In the last analysis the theory must include chemical, thermal, electrical and molecular forces. When two conducting surfaces are brought into such a degree of proximity as corresponds to the conception of a light contact, there is known to be a surface layer of gas between them, such as air, in a specially condensed form. The electrical resistance of this gaseous or liquid layer of non-conducting material is necessarily very large. Any cause which will expel this layer and bring the two surfaces into closer contact, will reduce this contact resistance. When the active cause is vibratory pressure, the arrangement becomes a microphone. When the active cause is electrostatic attraction or electrostatic puncture, the arrangement becomes a coherer.

It is a remarkable fact that essentially the same apparatus which produced the marvellously sensitive microphone transmitter for revealing the presence of sound-waves in the atmosphere, should also produce the delicate coherer for revealing the presence of ether-waves in the atmosphere. The nature of the action taking place in coherers is the subject of a number of rival theories. The purely electrostatic theory, as suggested by Lodge, contemplates electrostatic attraction between the ions in the adjacent opposing surfaces, whereby the electric difference of potential between the terminals of the coherer is enabled to draw the outlying pickets of the two surfaces more closely together, and effect a diffusion of the matter of one into that of the other. Another theory is that the electric potential-difference between the opposing contact-surfaces produces a disruptive discharge of molecular dimensions through the gaseous intervening layer, and that this discharge effects a minute weld with improved conduction. Yet another theory contemplates a change in surface tension over the opposed surfaces consequent upon electrification, and a partial expulsion of the gaseous layer in consequence, thereby reducing the surface resistance. It is quite possible that all of these conditions may occur simultaneously and that the reduction in resistance may, therefore, be attributable to the combined action of several causes.

The ordinary phenomena of the coherer contemplate only the original condition of non-conduction and the sudden change to con-

duction, under the influence of applied potential-difference. This is the case of the coherer that requires to be tapped or agitated in order to restore the original condition of non-conduction. The phenomena of the self-restoring coherer, or of the coherer that supplies its own internal agitation after the conduction has occurred, are more complex. They are presented only in special combinations of electrode-metals, such as carbon with carbon, carbon with another metal, or iron with mercury, etc. The fact that auto-decoherence is a property restricted to particular chemical associations, suggests the hypothesis that the restoring action is a secondary effect of the current which passes during the moment of coherence. The current seems to trip a molecular circuit-breaking mechanism, which destroys the contact effected electrostatically. It is suggested that oxidation accompanying minute sparking might account for the property. The oxidation might inject a thin film of oxide between the surfaces, as a substitute for the original atmospheric layer.

The property of auto-decoherence is apparently allied to the property of anti-coherence, in which the resistance of a contact, originally low, suddenly increases as soon as an electric impulse or discharge crosses the contact. Any satisfactory theory of auto-decoherence might, therefore, be expected to furnish a theory for the action of an anti-coherer. Nevertheless, it is quite possible that the principle of some particular anti-coherer might be quite different from the principle of some particular coherer in the action of automatic restoration. Finally, in the automatic restoration of an anti-coherer from the high-resistance to the low-resistance condition, entirely different causes must be invoked, such as absorption. Thus, if a layer of oxide injected between the surfaces on the passage of the discharge should be the cause of increase of resistance in an anti-coherer, any chemical action which rapidly and automatically reduced or removed this oxide would account for the automatic coherence, or restoration to the original condition. A wide field for useful research lies in the further analysis of the complex physical, chemical and electrical actions manifested in coherers and in anti-coherers.

MODERN ILLUMINANTS.

The properties of recent illuminants form the subject of two articles abstracted in this week's Digest. One of the papers in question deals exclusively with the Nernst lamp, which the author subjected to an exhaustive spectro-photometric study with the purpose of settling definitely the quality of the light under various conditions. The results, while not differing widely from those previously reported, are in some particulars rather striking. It was found that integrating all the radiation by means of the spectro-photometer, the actual color of the light from the Nernst lamp at rated normal current strength is very closely similar to that of the Hefner standard. At subnormal current strength the former is more reddish than the latter, but at currents above normal becomes whiter, rapidly approaching the color of the acetylene flame. This result appears at first sight most curious, since to the eye the Hefner standard is decidedly reddish, while the Nernst glower appears almost white. There is no going back of the returns to be allowed, however, and the changed appearance of the two lights to the eye must be set down to the sensory imperfections of that useful but erratic organ. The cause is doubtless the extreme difference in absolute brilliancy between the Hefner light and the Nernst, the strong red component of the latter being, as it were, drowned out by the intensity of the other components and their more active stimulation of the retina. In the step-by-step comparison with the spectro-photometer this effect disappears. It is a good example of the unusual and annoying difficulties that turn up in photometry. Another interesting fact brought out by the experiments was the absence of any noticeable selective radiation in the glower, contrary to the general impression regarding it.

The second note deals with the general view of some modern illuminants from the standpoint of current British practice. An interesting fact here brought out regarding the Nernst lamp is that it has been extensively used in Buckingham Palace for the last year and has there effected a saving in current of about 50 per cent. The Nernst lamp is generally credited with materially higher efficiency than the ordinary incandescent, but a difference of 50 per cent. would argue either poor incandescents to start with, a more efficient Nernst lamp than is found in American practice, or skill in the plan of the substitution of the one for the other. It is not an easy thing to compare the relative current taken by two lights used in succession to illuminate the same space, and figures obtained in this way are somewhat unconvincing. The author then considers the mercury arc, which he believes has a great future before it. This may be so, but some method of avoiding the color difficulty must first be found. Mercury arcs worked at unusually high intensity are to the eye less offensive than others on just the same principle noted with respect to the comparison between Hefner and Nernst lamps, but no amount of increased brilliancy will put into the mercury spectrum rays that are not there. In spite of the color question, however, the mercury arc may find a very considerable application where cheap light is the first consideration. The low-ampere, high-voltage enclosed arc is nearly or quite as offensive in color as the mercury arc, yet it has come into large commercial use, and that, too, in places where one would expect some sort of care in the quality of the illumination. Out of doors in certain classes of street lighting especially there seems no good reason why the mercury arc should not be freely used, at least so far as its color is concerned.

In spite of the work which has been done on the Nernst lamp, it has thus far made slow progress in American practice. The mercury arc is in a frankly experimental stage from which it may be expected to emerge albeit perhaps somewhat slowly. Meanwhile work on vacuum tube lighting proper goes on slowly and with somewhat indecisive results. Another promising line of investigation, on arcs between pencils in which carbon enters in part or not at all, is being vigorously pursued, but still with the promised land just a few days' march ahead. After all the research of the last five years or so, the incandescent lamp holds the field against all comers in spite of its manifest limitations. The enclosed arc has pushed its way into extensive use in this country, but is little used elsewhere on account of the large energy consumption of the device as a whole. American requirements demand the saving of labor as of prime importance, and no device that increases this item can make its way except by overcoming extreme inertia. The added labor in cleaning and renewals is one of the factors that tends against the Nernst lamp as against the incandescent. The mercury arc ought to be helped by this consideration unless the renewals should prove to be heavy. Technically the situation is extremely interesting, with four or five forms of high-efficiency lamps far advanced in the experimental stage and already beginning to find place in commercial practice. Eventually a device which is technically good is bound to make its way in the world, but sometimes very slowly against the pressure of competition. In the present instance it may be regarded as certain that some of the newer illuminants will come into considerable use, but which it would be rash to predict. No one of them seems to have, however, the elements of success to the point of revolutionizing the general art of illumination.

Terrible Disaster on Paris Underground Road.

A very serious disaster occurred on the Paris underground electric road on August 10, by which, according to the official estimate, 100 persons lost their lives, 84 bodies having already been found. The causes of the accident are engaging the attention of the officials. Several versions of the disaster have been reported, but the main facts which have been cabled are the following: "Train No. 43, which caused the accident, came from Porte Dauphine, at the entrance to the Bois de Boulogne, in the western part of Paris, and, passing under the Place de l'Etoile, where the Arc de Triomphe stands at the crest of the Champs Elysees, circled the northerly quarter of the city. In this northern quarter—a manufacturing section—the train picked up numbers of workmen, who, after their day's work, were returning to their homes in the populous eastern arrondisements of the city. On reaching the neighborhood of the Cemetery of Père La Chaise, the motor failed to act properly, and the train waited at the station of Les Charonnes until the arrival of a second train, which pushed the crippled train forward, making a total of sixteen coaches.

"After proceeding about 200 yards towards Menilmontant station, the damaged motor set fire to the engine of the first train. The fire burned fiercely, raising quantities of smoke. Simultaneously the electric lights on the trains went out, leaving the passengers in total darkness, except for the light of the burning engine far ahead. This impeded the progress of the trains toward Menilmontant.

"The terror-stricken passengers got out and tried to grope their way back to Les Charonnes. The current which continued in the rails is believed to have stunned or killed many. A number of the passengers managed to reach Les Charonnes station, but the main body of the passengers was overcome by the heat and smoke. A terrible panic occurred among those behind, and the horror of the situation was increased by a third train crashing into the fiery mass, and adding another crowd of panic-stricken passengers to those seeking an outlet. Owing to the dense suffocating smoke, few passengers escaped, and it was some hours before rescuers could penetrate into the tunnel."

It is believed that the conditions in New York, with fire-proof cars in the subway will not allow such an accident to occur there. In London elaborate precautions have been taken to minimize the danger in the tube system. A cable dispatch from Berlin of August 11 says: "The tunnel disaster on the Paris Metropolitan Railroad has caused the management of Berlin's new electric road, which is partly underground, to make a speedy investigation into whether a similar accident was possible here. Experts, after carefully examining to-day the cars, motors and the three underground stations, concluded that no danger exists, and that it is unnecessary to change the construction of the cars."

The Curability of Cancer.

Considerable attention is being paid in this country to the treatment of cancer by the Röntgen ray and much hope has been entertained as to some of the results. Work has also been going on in Europe, and some results are now reported from England by cable. One report was made on August 7 by eminent bacteriologists, who have been engaged entirely in the last six months in research work at the laboratory of the Royal College of Surgeons, under the auspices of the cancer research fund. Drs. Murray and Bashford, who were among those appointed investigators, declare that nothing is being neglected by the committee, and consequently much research has taken place with respect to incipient cancer in lower animals, yet the causes of cancer in these animals are often of an entirely different nature from those in man. The parasitic conditions are different, while the treatment which would be adopted and proves successful in the cases of animals, could never be applied to human beings. The cancer cure, said one of the physicians, will never be discovered by one man. When it is found it will be by the continuous efforts of every one engaged. One little clue leads to another and nobody hides anything or tries to hide anything from his colleagues. Moreover, there is not the slightest intimation in the report presented a week ago to the first annual meeting of the Cancer Research Fund Committee that any definite results from the experiments are imminent.

Prof. Duguet, an eminent Paris physician and professor in the French Academy of Medicine, declares that the experiments hitherto made have revealed nothing on which to base scientific treatment. He says: "We are still groping in the dark with regard to the reported cures by the X-rays. My long experience in the largest hospitals in Paris has made me most sceptical. Believe me, these 'cures' are not definite." The Middlesex Hospital in London is the pioneer in cancer research in Great Britain. It receives suggestions of cures from all parts of the world weekly. Many are fairly tried, but hitherto without success. The Middlesex Hospital doctors authorize the positive statement that, while they do not assert that they have effected anything like a cure by means of the X-rays and Finsen light treatments, yet the pain has been minimized.

Results of the International Telegraph Conference.

The German Chamber of Commerce has received the following notice from the German Post Office Department:

The International Telegraph Conference in London has resolved to abstain from the compulsory introduction of the official vocabulary for cipher telegrams, issued by the Berne International Bureau of telegraph administrations. Instead of such a limitation, a considerable increase in the number of words permissible for cipher telegrams has been approved. According to the resolutions passed in London (which still require the approval of the various governments and presumably will not go into effect prior to July 1st, 1904), there may be used besides those heretofore permissible all such words, no matter whether actual or artificially constructed, as are so constituted that their syllables may be pronounced in the German, English, Spanish, French, Dutch, Italian, Portuguese or Latin languages. Cipher words may contain, as heretofore, up to ten letters, according to the Morse alphabet.

This provision embraces the entire vocabulary issued by the International Bureau of Telegraph Administrations at Berne, and all word constructions whose syllables show such a change of vowels and consonants as to be utterable in accordance with the usage of any of the foregoing languages. On the other hand, such cipher words are prohibited as contain a group of consonants and vowels not enunciable in the languages. In all such words, each five letters would count as a word.

A combination of two or more open words will not be permissible in cipher telegrams.

The object of the resolutions is to render more lenient the rules governing cipher words without encumbering telegraphing by word formations that are apt to prevent the rapid comprehension and transmission of the characters.

Development of High Speed Traction.

A cable dispatch from Berlin, Germany, of August 11 says: "A statement is published here to-day, evidently from information given by Privy Councillor Rathenau, managing director of the Allgemeine Elektricitäts Company, regarding the object of his forthcoming visit to the United States. According to the statement he will conduct negotiations for the delimitation of the spheres of interest of the Allgemeine Elektricitäts Company and the General Electric Company in neutral countries, thus avoiding mutual competition. His visit also has reference to the exchange of experience, designs, patents, etc. Herr Rathenau will examine the situation in the United States, with a view to the utilization there of the experiments which the German electric companies have made during the past two years in electric high-speed traction on the standard-gauge road from Berlin to Zossen."

"The statement intimates that American capitalists are ready to undertake a broad-gauge long-distance electric road with the cooperation of the great Berlin companies, and that the latter are more than ready to place the results of their experiments at the disposal of the American exploiters, since it is considered that such a course would be the quickest way of inducing the government authorities here to undertake the application of the same system on German soil.

"Although the Zossen experiments demonstrated the possibility of 100 miles an hour, the experimenters believe that it will be a long time before the government and the legislators can be persuaded to inaugurate the system of high-speed transit between the chief cities of the empire. The statement concludes: "The sooner the practicability of the German experiments is proved in the United States, the sooner can we expect the introduction of electric high-speed trains in our own country. This would insure a new period of prosperity for the electrical industry."

The Electric Installation on Board U. S. Battleships Connecticut and Louisiana.

BY R. M. KLEIN.

THE *Connecticut* and *Louisiana*, the two 16,000-ton battleships now under construction, the former at the New York Navy Yard, the latter at the works of the Newport News Shipbuilding & Dry Dock Company, represent a new type of battleship, greater in displacement than any heretofore designed for our navy and carrying heavier armament than any warship now afloat, either in our navy or abroad.

The main battery consists of four 12-in., eight 8-in. and twelve 7-in. breech-loading rifles. The 12-in. guns are mounted two each in a forward and after turret, the 8-in. guns two in each of four turrets arranged one at each corner of a rectangle, or what is commonly known as quadralateral turrets, the 7-in. guns are each in a separate armored compartment on the gun deck. The secondary battery consists of twenty 3-in. (14-pounder) rapid-fire guns, twelve 3-pounder, seven automatics, and numerous guns of smaller calibre.

The use of electricity aboard modern naval vessels is so extensive that to interrupt the supply during action would mean certain defeat for a vessel were she matched against any vessel which approached her equal. Realizing the importance of the above, these battleships have been designed to carry two complete and independent electric plants each capable of handling the entire load which may be required in action.

The electric applications aboard ship are divided into three distinct classes: (1) Illumination, (2) power for driving auxiliaries, (3) signaling or communication.

The lighting system is installed as two distinct systems, each having separate feeders and mains and known as the "Battle Service" and "Lighting Service." The battle service comprises all lights below the protective deck, including those in engine and fire rooms, magazines, store rooms, and the like; all lights at guns, ammunition hoists, winches, cranes and other auxiliaries whose operation may be required during action; signaling lights, the ship's running lights and only sufficient other lights in passages to afford convenient access to the various portions of the ship. When necessary to install a light in a location which might render it visible by the enemy, a "battle lantern" is used, this lantern being fitted with a sliding screen which allows the light to shine only over an arc of about 90°, and can be entirely screened if required, this feature being identical with that of the ordinary bull's eye or dark lantern.

The battle service will efficiently light all parts of the ship subject to access during action, and all other auxiliaries whose manipulation and operation during action is essential, but at the same time to shield all lights against external visibility.

The lighting service includes all lights not included in the battle service, such as lights in state rooms, offices, mess rooms, crews' spaces, and the like, and also supplies current to the desk and bracket fans in officers' quarters. To efficiently light each of these vessels requires the use of eleven hundred fixtures, of which about 730 are on the battle service, the remainder being on the lighting service.

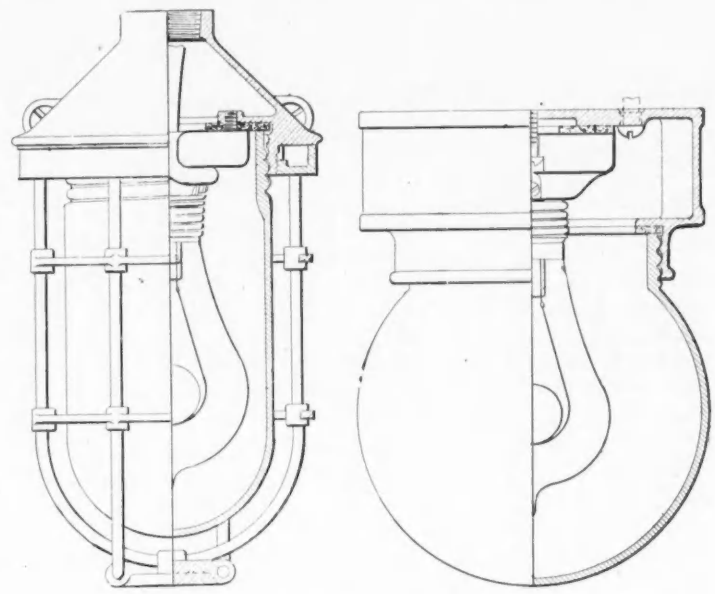
The fixtures used are simple in design and neat in appearance, the types most used being the steam tight globe (Fig. 1) and the ceiling fixture (Fig. 2). These consist of a casting which has a boss into which the conduit carrying the wires taps, and a knuckle thread into which the glass globe screws, the lamp socket being secured to the casting by machine screws, a rubber gasket intervening. The steam-tight globe is protected by a stout metal guard, as shown in the illustration. This type of fixture is made in three types, differing only in the method of support; that shown in Fig. 1 is the bulkhead type and is secured by a bracket cast in one with the conical-cap, the other types being the drop type, which is supported by the conduit alone, and the deck type, in which the conduit enters the fixture from the side instead of the top, the fixture being supported by a bracket cast across the top of the conical cap.

The ceiling fixture is used in passages around the officers' quarters, in reception cabins, mess rooms, and the like, and is the standard overhead light for all locations, in which the fixture is not liable to injury. The steam-tight globe is used in engine and fire rooms, ammunition passages, store rooms and is the standard fixed light for all locations where the fixture is subject to injury.

Six 30-in. hand-control projectors, or searchlights, will be installed. These will be located, one on a platform at the base of the fore topmast, two on the flying bridge, one on a platform at the base of the main topmast, and two on a platform on the mainmast well above the after bridges. Each projector will be equipped with a horizontal lamp designed for both hand and automatic feed. Specifications require each projector to project a beam of light of sufficient intensity to render plainly discernible on a clear dark night a light-colored object 10 x 20 ft. in size, at a distance of not less than 6,000 yards. Each light will operate on a 125-volt circuit in series with a regulating rheostat, and require a current of about 80 amp. with 60 volts across the arc.

Motors will be used for the following purposes: (*a*) To drive ventilating fans and blowers, (*b*) carrying ammunition from magazines to hoists, (*c*) hoisting ammunition, (*d*) turning turrets, (*e*) elevating and depressing guns, (*f*) ramming shells into the breech of guns, (*g*) to operate deck winches, (*h*) to operate boat cranes, (*j*) to whip ammunition from the main deck to the bridge and military tops, (*k*) for laundry machinery, (*l*) for driving tools in machine shop, (*m*) for operating automatic power doors, (*n*) for operating fresh water pumps and sanitary pumps.

The ventilating system comprises thirty-three fixed fans, varying in size from those requiring a fraction of a horse-power each for their operation, to 80-in. steel plate fans requiring 11 horse-power each. Each of the above fans will be driven by its own independent shunt-wound electric motor, direct-connected, the control panel containing the usual starting resistance fitted with automatic overload and no voltage release. All fans are designed to deliver their specified amount of air at a pressure of 1 oz. when running at normal speed, but are capable of being driven at about double normal speed, in which case the air is delivered at a pressure of 1½ oz. The speed control is effected by varying the resistance except for the smaller fans, in which case resistance in series with the armature will control the speed.



FIGS. 1 AND 2.—BATTLESHIP FIXTURES.

In addition to the above, each ship will be supplied with six small portable electric fans, each consisting of a ¼-hp series motor mounted on a common shaft with an exhauster which it drives at a speed of about 2,200 r.p.m., causing a delivery of about 500 cu. ft. of air per minute (free exhaust). These sets are very compact, the overall dimensions being about 18 x 18 x 12, and weigh approximately 100 pounds. They are used for temporary ventilation when necessary to work in such localities as are not reached by the main ventilating system, such as double bottoms, inside of boilers and the like. Each of these sets is supplied with two 25-ft. lengths of canvas hose with couplings permitting of attachment to inlet and outlet of exhauster or to attach together, forming a 50-ft. length, which can be connected to either the inlet or the outlet of the exhauster.

The officers' quarters, wardrooms and the like are liberally fitted with desk and bracket fans, the former being 12 in. in diameter, rated at 1/12 hp, the latter 16 in. in diameter rated at ⅙ hp. Forty-five of the former and eight of the latter will be installed on each vessel.

At a comparatively recent date a ship's ventilating system consisted of a few large-sized blowers, generally located in pairs with

large main ducts having many turns, bends and with branches leading to the various compartments. This system required an excess in air pressure at the fan in order to maintain a certain head at the discharge outlet, owing to the loss by friction of the pipes and to the indirect leads of the main ducts. Many of the principal water-tight bulkheads were pierced by the ducts and this necessitated the use of valves so installed as to be of convenient operation, which could be closed in an emergency to maintain the water tightness of the various compartments below the water line. All leads through the protective deck required armored bars or gratings in the openings.

The ventilating systems of the *Connecticut* and *Louisiana* are so designed as to minimize the number of leads through the protective deck, and in no instance is any one of the principal water-tight bulkheads pierced by a ventilating duct. The flexibility of this system employing a number of small units as compared with a few large ones, possesses many advantages which are at once apparent, and the installation of such a system is only rendered possible by the use of the electric drive.

Conveyor motors are used for carrying ammunition from the magazines, along the passages to the base of the ammunition hoists. Four conveyors will be installed, two leading aft from the forward magazines, one on the port side and one on the starboard side, and two leading forward from the after magazines, one port and one starboard. Each conveyor will be about 80 ft. long and will consist of two endless sprocket chains with metal aprons and stiffeners at suitable intervals. Motors, one to each conveyor, will be shunt wound, reversible, of about five hp, and will drive through gearing.

Twenty-six endless chain ammunition hoists, each driven by a 3-hp motor, will deliver the ammunition from the lower passage to the 7-in. guns and secondary battery. These are in addition to the ammunition hoists for the turret guns. All the main battery guns will be supplied by hoists leading direct from the lower passages, but certain guns of the secondary battery are so located as to require the ammunition being hoisted first to the berth deck, then carried along to other hoists and raised to the upper deck at the gun locations.

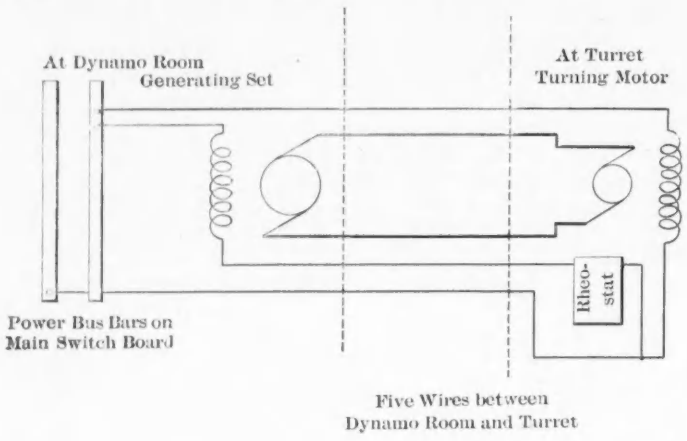
The new arrangement of the main broadside battery, wherein by means of a center line armor bulkhead on the gun deck and suitably located transverse armored bulkheads, each of the twelve 7-in. guns is located in a separate armored compartment, renders imperative a separate ammunition supply for each gun. On former vessels the main broadside battery was installed in a more or less open compartment, which would render possible the supplying of ammunition to more than one gun from the same hoist. The new arrangement in which a gun would be temporarily rendered *hors de combat* by a failure of its individual ammunition hoist adds to the importance of this electrical application and the reliance which must be placed in the electric motor and in the ability of the ship's plant to furnish the necessary power under any and all conditions.

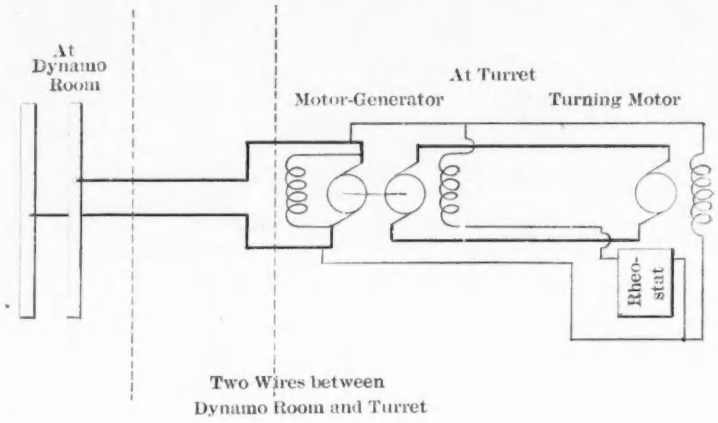
Each ammunition hoist motor will be shunt wound, reversible, enclosed, dust and moisture tight, with suitable openings (fitted with water-tight covers) to allow inspection and adjustment to brush rigging and the like. Motors will be geared to the ammunition hoist sprockets, each armature shaft being fitted with a solenoid brake, which will set automatically and prevent turning of the armature in case of failure of the line voltage.

Each of the six turrets with its respective pair of guns will be equipped for electrical rotation. This will be done by fitting each turret with two motors of equal capacity, either one of which will be capable of operating the turret in case of failure on the part of the other, although normally they will both operate in parallel. For the 12-in. turrets two motors of not less than 25 hp will be installed in each, and for the 8-in. turrets, two motors of not less than 15 hp will be installed in each. As in previous battleships, the Ward Leonard system of control will be used, but a modification of former naval practice will be introduced for the operation of these auxiliaries which renders possible a material reduction in the capacity and number of generating units in the ship's electric plant.

Reference to Fig. 3 will show the method of applying the Ward Leonard system of control to turret turning, as installed on many ships of our navy, and which up to the present time has been standard practice for this electrical application.

A separate generating set is required especially for each turret, it being further necessary to render the generator a shunt machine and separately excite its field before it is available for turret turning. The generator terminals are led direct to the turning motor, terminals, the field of the generator being led through a variable resistance, the latter being controlled by the turret operator. It will be readily seen that the motor, having a separately excited field, will run at a speed proportional to the impressed armature voltage, the latter being dependent on the field current of the generating set, which is controlled by the turret operator; and furthermore, the motor speed will be definite for any fixed position of the controller handle, and that speed will be maintained against any and all variations of load, due to friction, listing of the ship, the impact of a shell, up to the point where a fuse blows or a circuit-breaker is thrown.





Figs. 3 and 4.—Circuits of Turret Motors.

While the above adaption of the Ward Leonard principle attains the desired result, viz.: a precise, definite and, if required, constant speed of rotation of the turret, it is only acquired at the expense of a large number of units in the generating plant and a certain amount of complication on the switchboard and in the ship's wiring. These drawbacks grow more marked as the number of turrets in the ship increases. On ships of the *Virginia* class, each of which has four turrets, the electric plants consist of two 100-kw and 50-kw generating sets. Of these, five 50-kw sets (four in operation and one in reserve) must necessarily be assigned to the turret turning system. Not only a large number of sets must be used, but a total of 250 kw of the plant is used up in the turret-turning system, whereas not over 65 kw will be consumed in operating the turrets, considering all of them in operation at full load at the same time, the latter supposition being most highly improbable. Smaller units than 50 kw could not be installed, as the system of interchangeability prevalent in naval installations would be marred by the inability of the small units to handle either the lighting or the searchlight load of the ship, should emergency so require.

The *Connecticut* and *Louisiana*, each with six turrets, would require a rather cumbersome electric plant if equipped on the above outlined scheme. Instead, a motor-generator designed for comparatively high speed and consequently compact and not over heavy will be installed in the barbette of each turret. The motor end will be connected direct to the main power bus-bars of the main switchboard, the connections between the generator end and the turning motors being identical with those used in the former scheme, embracing individual generating sets. This latter scheme not only

allows the operation of all the turrets on one generator or set of generators in parallel, but presents the advantage of subtracting from the reserve power of the plant only such energy as is actually consumed in turning the turrets. This scheme is shown diagrammatically in Fig. 4.

It is estimated that under the severest service conditions the combined power used in turning the turrets will not exceed 60 kw. Furthermore, in the individual generating set scheme (Fig. 3), although the operation of a turret at a variable speed would call for a variable amount of power to be supplied from the dynamo room, the current flowing in the circuit would be practically constant for all speeds of rotation, as in this system the voltage is the variable function in the power equation. This requires the circuit between the dynamo and turret-turning motors to be designed (considering heating of conductor) on a basis of carrying full load current throughout the time of operation of turret. In the latest scheme, that involving motor generators, although the generator end of the appliance is furnishing about full load current at variable voltage for the several stages of the turret operation, the motor end is drawing from the line a variable current at constant voltage; consequently the lead between motor generator and dynamo room needs only to be designed (considering heating of conductor) for about half the current carrying capacity of that necessitated by the first proposition.

As the motor generators are located practically adjacent to the turning motors, it will be seen that the lead between turret-turning motors and generating set in scheme 1, is nearly identical in length with lead between motor generator and dynamo room in scheme 2; keeping this in mind, the former paragraph clearly illustrates economy in transmission as well as economy in cost of apparatus, reserve power and weight.

The 7-in. guns of the main battery and all secondary battery guns are trained solely by hand power. Each turret gun, however, is mounted on trunnions and elevated or depressed to the proper angle by means of an electric motor. As the guns are balanced on the trunnions the elevating or gun training motors merely have to overcome the friction load; or in case a shell is inserted in the breech of the gun prior to the elevation of the gun to the proper angle, the training motor is subjected to a load in excess of the friction load if depressing the muzzle, and a load smaller than the friction load if elevating the muzzle. Each 12-in. gun will be equipped with a 5-hp gun-elevating motor, and each 8-in. gun with a 2.5 hp gun-elevating motor. These motors will be shunt wound, reversible, enclosed, waterproof, with the usual hand holes for inspection. Rheostatic control will be used.

For ramming the shells into the breech of the 12-in. and 8-in. guns, a "rammer motor" is installed, one for each gun. These motors are series wound and subject to loads which are largely in one direction. They operate the rammer through a friction drive so adjusted that in case the shell is set home before the motor is stopped, the clutch will slip before the motor draws sufficient current to throw the circuit-breaker. Each 12-in. gun will be equipped with a 7-hp rammer motor and each 8-in. gun with a 5-hp rammer motor.

Each turret gun has its individual ammunition hoist, which works on the principle of cables or hoisting ropes winding on and off a drum which is actuated by an electric motor. The motors will be operated through a controller with a single handle which will allow sudden reversal; the carrying of the load in either direction; the automatic locking of the drum against rotation in either direction, when the current supply is cut off, and the operation of the motor when under any load on each of five speeds. For the 12-in. guns the motors must handle a load of about 3,200 pounds, and will be of about 30 hp each. For the 8-in. guns the motors must handle a load of about 1,000 pounds, and will be about 8-hp each.

Each ship will be fitted with six double-headed winches, two forward on the main deck, two on the upper deck in the waist of the ship and two well aft on the quarter deck. These winches will be used in coaling ship, handling anchors and in stowing cargo. Each winch will be operated by a 25-hp motor. These motors will be series wound, reversible, enclosed, water tight and designed to withstand strains due to increase of speed on sudden removal of the load. The two forward main deck winches must each be capable of hoisting a 2,200-pound load at a speed of 300 ft. per minute, and the same load at a speed of 30 ft. per minute; the two upper deck winches to hoist 2,200 pounds load at a speed of 300 ft. per minute, the quarter deck winches to hoist a 2,200-pound load at 300 ft. per minute, and a 13,200-pound load at 50 ft. per minute. Specifications allow an option between gearing and electric devices for obtaining the necessary speed variations.

Two boat cranes will be used to handle the ship's boats and launches, of which each ship carries a sufficient number to float her entire complement of over 800 men. The cranes will be electrically operated with separate motors for hoisting and for rotating. Crane requirements specify a hoist of 33,000 pounds at a speed of 25 ft. per minute, and a rotation at the rate of one revolution per minute, while carrying the above load and with the ship heeled 10°. Motors will be enclosed, water tight and reversible, the hoisting motor being series wound. Hoisting motors will be about 50 hp each, and rotating motors about 30 hp each. Both motors will be located on a platform which revolves with the crane. The revolution embracing a complete rotation, it will be necessary to lead the electric wires to the crane motors through contact rings and brushes; the former will probably be on the rotating crane, the latter being the terminals of the feeder.

Laundry machinery will be electrically driven by an enclosed motor of about 10 hp. The machinery workshop of each vessel will include a 48-in. extension gap lathe; a 14-in. lathe, a 15-in. stroke column shaper, a vertical drill press, a 16-in. sensitive drill, a universal milling machine, a combined hand punch and shears, an emery grinder with two 12-in. wheels, and a 30-in. grindstone. All the machine tools will be electrically driven, either direct-connected or through shafting and will require from 10 to 15 hp.

All doors leading between boiler rooms, between engine rooms, between boiler and engine rooms, from boiler rooms into bunkers, at the ends of the main ammunition passages and the like, and the main hatches through the protective deck, both fore and aft—in all 42 doors and five armor hatches—will be worked on a power system. Each such door or hatch will be capable of operation on the spot by hand or by power, from either side of the bulkhead or deck, and all must be capable of being closed by power simultaneously from an emergency station, which will probably be located in the pilot house. If electrically operated doors are used, a 1-hp motor will be installed at each door and hatch, 47 in all. If pneumatic power is used, a motor-driven air compressor will supply the energy. In the latter case the motor will be automatically stopped and started by pneumatic operation of the controller. An indicator at the emergency station will enable the operator to determine whether any door or hatch is open or closed.

Two 2-hp motors driving centrifugal pumps will be used in connection with the fresh water system for circulation between the distiller and the various tanks. Motors will be automatically stopped and started by means of floats operating the controllers. Two 6-hp motors driving centrifugal pumps will be used in connection with the salt water sanitary service or flushing.

Provision will be made for the installation of a wireless telegraph outfit. This outfit will be supplied by the government and installed probably after the vessels are constructed and placed in commission. Pending the selection of the most satisfactory apparatus, in connection with which exhaustive experiments are now being conducted, no definite information on this subject as applied to the case in hand is available. Provision, however, will be made for supporting the aerial wires and sufficient deck space will be reserved for the installation of the apparatus of such system as may be eventually adopted, or as may be installed for experimental purposes.

An extensive application of electrical apparatus will be found in the systems of communication aboard these vessels. About 90 voice pipes will be installed, most of which will be fitted with suitable electric calling devices in the shape of push buttons, bells, buzzers and annunciators.

A liberal disposition of push buttons in the officers' quarters allow the calling of the various pantries, orderlies, messengers and the like, to the various staterooms, cabins, officers and messrooms as required. A telephone system comprising some twenty-five lines, running to a central station, will be installed. In addition several private lines are installed, such as between navigator's stateroom and dynamo rooms, between chief engineer's stateroom and engine room, between surgeon's stateroom and dispensary, and the like.

In the various living spaces of each ship, single-stroke electrically-operated gongs, 12 in. in diameter, are installed. These gongs can be operated all simultaneously, from either the captain's stateroom, pilot house, conning tower or executive officer's stateroom. The circuit closers are automatic in operation and ring the gongs con-

tinuously for 30 seconds when set in motion. These signals, known as general alarm gongs, are used for calling the men to quarters.

Located in spaces below the protective deck and at the main hatches leading below this deck, warning signals, or water-tight door alarms are installed. These consist of solenoids operating a plunger in such a manner as to force air through a whistle, which gives forth a shrill sound. These warning signals are all capable of being operated either from the quarter deck or the pilot house. They are used to give the signal for closing all water-tight doors and hatches, which is done when danger from collision or other cause is imminent.

Thermostats are installed in all coal bunkers and magazines and all storerooms containing combustible material. They consist of a helical metal coil having a high temperature coefficient. This coil is mounted with one end free, in such a manner that the torsional effect produced by a slight rise in temperature causes a slight displacement of the free end. This closes an electric circuit, which leads to a drop on an annunciator located under the eye of the captain's orderly. These thermostats are enclosed in a heavy composition case and are sufficiently strong to allow their installation in any portion of a coal bunker. It is customary to install them well down in the bunkers at about the depth which experience dictates is most subject to spontaneous combustion. Coal bunker and storeroom thermostats are set for 200° F., and magazine thermostats for about 100° F. A total of 171 thermostats will be installed on each vessel, of which about 70 will be in coal bunkers and 67 in storerooms, each group being on a separate annunciator.

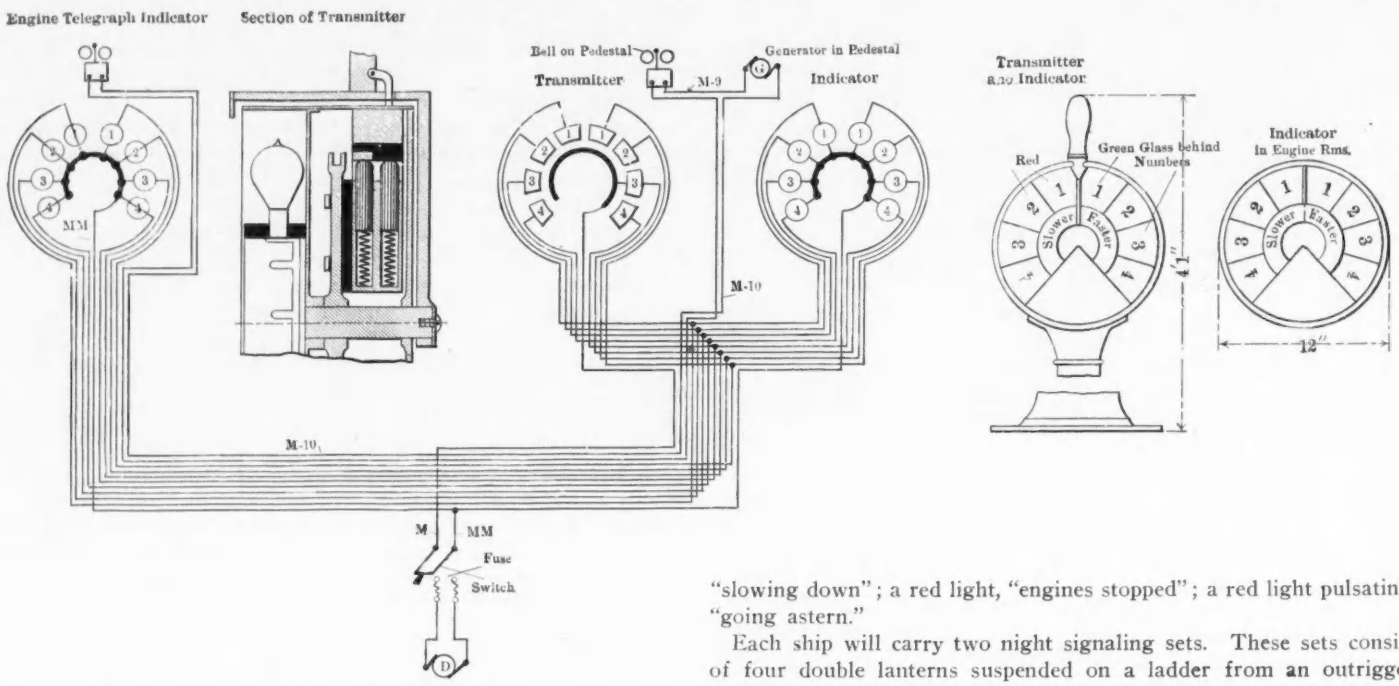


FIG. 5.—ELECTRICAL ENGINE ROOM TELEGRAPH.

Electric revolution indicators will be installed in the pilot house and conning tower for signaling the number of revolutions of each main engine shaft. These indicators will be of the "tick-tack" type, each revolution of the shaft closing the circuit through an electric magnet on the indicators, which in turn draws down its armature and causes a pointer to vibrate through an angle of about 30°. Each indicator has a pointer and magnet for "ahead" and "astern," corresponding to "forward" and "reverse" rotation of the engines.

Electric engine telegraphs located in the pilot house and in the conning tower, with indicators in each engine room, will permit slight variations in speed to be signalled. These instruments are of the "lamp" type, and consist of 5-cp electric lamps arranged in separate compartments, over the face of which are brass templets with the desired order cut through. By illuminating the lamp in any compartment, which is done by closing the circuit at the transmitter, the light shines through the letters or figures on the dial or the brass templet and indicates the desired order. An engine telegraph and indicator with diagram of connections is shown in Fig. 5.

Helm order telegraphs located in the pilot house and conning tower, with indicators at all steering stations, will permit of electrically signalling to the helmsman the desired helm angle. These instruments are similar in construction to the engine telegraphs except that the markings and the number of indications are different.

Electric rudder indicators of the lamp type (Fig. 6) located at all steering stations and connected to a transmitter on the rudder head, will indicate the angle at which the rudder is set and acts as a check in determining if an order transmitted to the helmsman by the helm order telegraph has been carried out.

For each turret ammunition hoist an indicator will be installed which will show the operator in the turret when the ammunition car is loaded and ready for hoisting, and also during the lowering of the car, when it is approaching the lower limit of travel. These indications will consist of lamps in view of the turret operator, which are automatically lighted and extinguished by contacts operated by the passage of the ammunition car.

The top of each mast will be fitted with a double truck light, which consists of two 32-cp lamps mounted one in a red and the other in a white lens. Both truck lights will be controlled by one "double-truck light controller" located on the forward bridge. This controller permits the illumination of either light on either truck, which light can be pulsated by means of a pulsator on the side of a controller. These lights are used to signal when cruising in squadron formation. A white light signals "steaming ahead," a pulsating of white light "slowing down"; a red light, "engines stopped"; a red light pulsating, "going astern."

Each ship will carry two night signaling sets. These sets consist of four double lanterns suspended on a ladder from an outrigger near the truck of each mast (Fig. 7). Each lantern consists of two 32-cp lamps mounted in pressed glass Fresnel lenses, one lamp of each double lantern being mounted in a red lens, the others in a white lens. The lanterns will be spaced 12 ft. apart. By means of a suitable keyboard on the bridge, the red or the white light in any or all lanterns or any combination of red and white lights on the four lanterns (only one light on each lantern) can be illuminated. By means of a pre-arranged code of signals, messages can be transmitted to any station within range of visibility of the lights. The use of two night signaling sets, one suspended from the foremast swinging outboard to port, the other from the mainmast swinging outboard to starboard, permits signaling to any station regardless of its bearing to the ship's head; whereas with only one night signaling set the relative location of the ship and the station to which it is desirous of signaling might be such that the mast from which the lanterns are suspended would intercept the path of the light and render the signal indiscernible. The keyboard is mounted on a pedestal and is enclosed in a case with a hinged cover. The apparatus is similar in appearance to a typewriter keyboard, and the depression of a single key displays the desired combination of lights. A cable of 16 conductors running to the lanterns enters the keyboard through a detachable water-tight coupling.

A summation of the electric auxiliaries on each ship with the probable maximum current required by each group, both for "in action" and for "cruising efficiency" is given in the following table. In estimating current required for the various motors, efficiencies varying from 80 per cent. up have been assumed, depending on the size of the motor:

Name of Appliance.	Horse power.	Number in installation.	Number used in action.	Used for cruising.	Amperes: total installation.	Amperes: total used in action.	Amperes: probable used in action.	Ratio: probable to total in action.
Incandescent fixtures	....	1100	800	700	550	400	270	⅔
Arc lamps	....	10	10	10	35	35	35	1
30-inch search lights	....	6	6	2	450	450	300	⅔
Fans, 1-12-H.P.	....	45	....	45	23	....	....	..
Fans, 1-6-H.P.	....	8	....	8	8	....	....	..
Port. vent. sets ¼-H.P. ...	....	6	....	6	18	....	....	..
Interior communications	....	....	....	....	?	....	25	..
Total	....	....	....	....	....	885	630	..
Main vent. blowers	¼ to 10	33	33	33	950	950	630	⅔
Ammunition carriers	4	4	4	....	120	120	120	1
Ammunition hoists, chain..	3	26	26	....	570	570	285	½
Ammunition, turrets, 12" guns	30	4	4	....	800	800	535	⅔
Ammunition, turrets, 8" guns.	8	8	8	....	450	450	300	⅔
Gun elevating motors, 12" guns	5	4	4	....	140	140	70	½
Gun elevating motors, 8" guns	2½	8	8	....	160	160	80	½
Gun rammer motors, 12" guns	7	4	4	....	200	200	*	..
Gun rammer motors, 8" guns	5	8	8	....	280	280	*	..
Turret turning motors, 12" guns	25	4	4	....	670	335	170	½
Turret turning motors, 8" guns	15	8	8	....	840	420	210	½
Smoke blowers	½	12	12	....	50	50	25	½
Deck winches	25	6	....	6	1000	....	....	..
Boat cranes, hoisting	50	2	....	2	660	....	....	..
Boat cranes, rotating	30	2	....	2	400	....	....	..
Whip hoists	3	6	6	....	130	130	65	½
Laundry motor	10	1	....	1	70	....	....	..
Machine shop motor	10	1	....	1	70	....	....	..
Powder door and hatches ...	1	47	47	....	350	350	120	⅓
Fresh water pumps	2	2	....	2	30	....	....	..
Sanitary pumps	6	2	....	2	80	....	....	..
Total	....	192	176	49	9129	4953	2610	..

* Rammer motors not operative during hoisting of ammunition.

The entire electric equipment of each ship aggregates 9,129 amp., which at the standard voltage of 125 corresponds to 1,141 kw; and the total power required by auxiliaries which are operative in action, corresponds to 885 amp., or 110.6 kw for the lighting and projector load, and 4,955 amp., or 619.4 kw for the power load, making a grand total of 730 kw. As many of the battle auxiliaries are of such a nature as to be subject to intermittent service, the probable maximum battle load is well below this figure, the estimated values being as indicated in the next to the last column, viz.: 630 amp., or 78.8 kw for the lighting and projector load, and 2,610 amp., or 326.2 kw, for the power load, making a grand total of 405 kw.

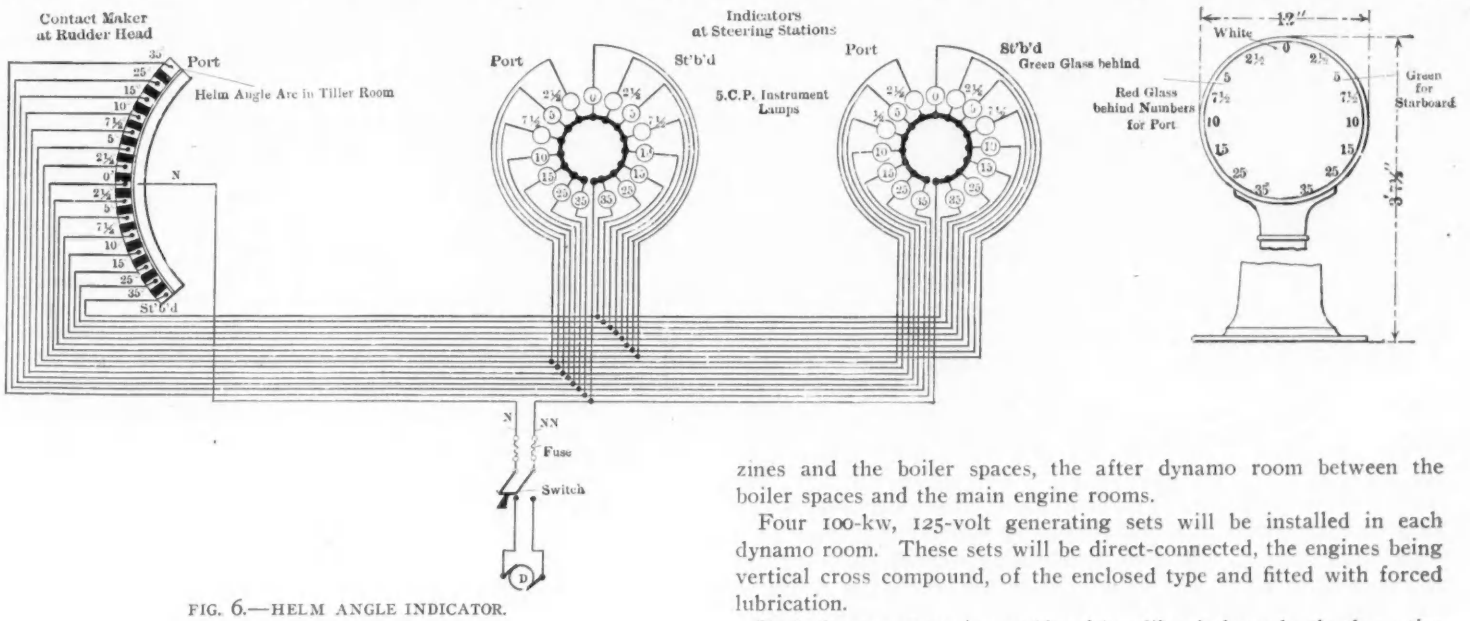


FIG. 6.—HELM ANGLE INDICATOR.

As previously stated, two independent power plants will be installed on each ship, and are designated as the forward dynamo room and the after dynamo room. Both will be located beneath the protective deck on a platform whose level comes between the upper platform and the lower platform, this special platform being necessary to secure sufficient headroom to install the generating sets. The forward dynamo room is located between the forward magazines and the boiler spaces, the after dynamo room between the boiler spaces and the main engine rooms.

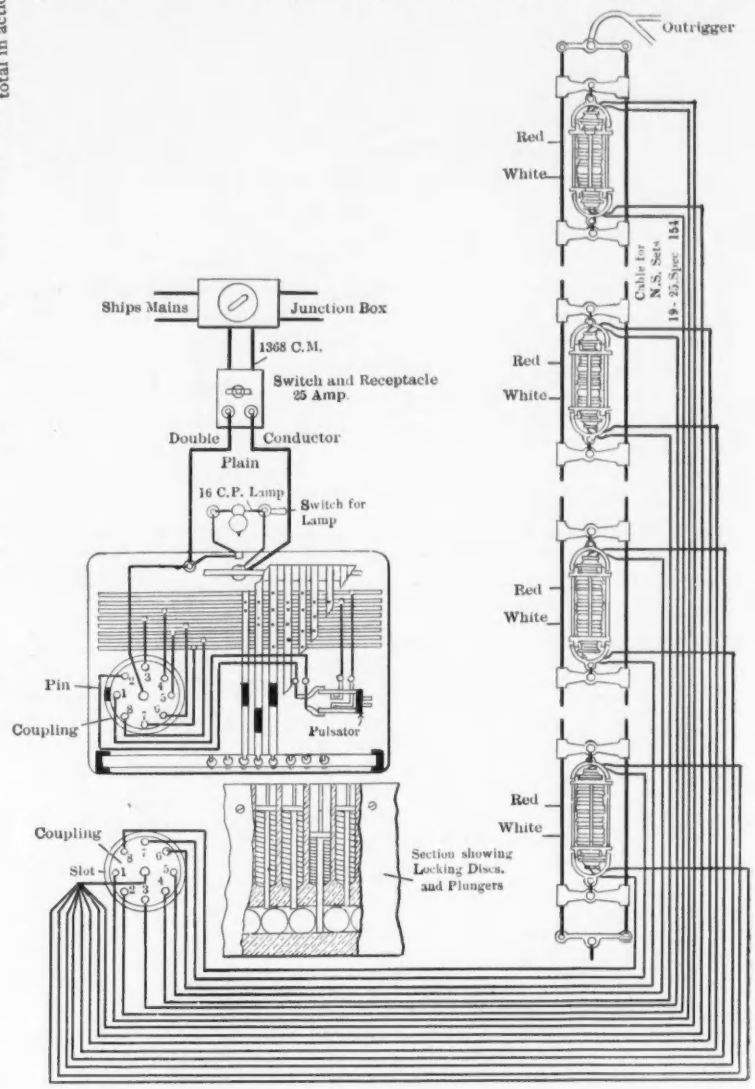


FIG. 7.—NIGHT SIGNAL SET.

Four 100-kw, 125-volt generating sets will be installed in each dynamo room. These sets will be direct-connected, the engines being vertical cross compound, of the enclosed type and fitted with forced lubrication.

Each dynamo room is capable of handling independently the entire battle load. This arrangement was considered imperative in view of the extended application of the electric drive to the important battle auxiliaries and in view of the danger of the electric plant being rendered inoperative from the following causes:

(*a*) Dynamo room rendered uninhabitable by breaking of a steam

pipe. (*b*) Dynamo room rendered uninhabitable by flooding of the compartment. (*c*) Generators or engines being damaged by heavy short circuits. (*d*) Damage to compartment by shell from the enemy.

Distribution of energy to all battle service when one dynamo room is out of commission and uninhabitable necessitates either duplicating the wiring to each auxiliary, viz.: one circuit leading from each dynamo room with a throw-over switch at each auxiliary; or wiring from distribution boards which are located external to and yet capable of electric connection to each dynamo room at will. This latter scheme has been adopted, using two main distribution boards, one adjacent to each dynamo room, and in addition duplicate wiring has been specified for certain of the more important circuits.

Convenience dictates that the switchboards for control of the generators be located in the respective dynamo rooms, and that the distribution boards be located adjacent to the dynamo rooms. These distribution boards are, furthermore, each in its water-tight compartment, these compartments being each provided with a water-tight door leading direct into the adjacent dynamo room and with another door permitting access to the compartment independent of the dynamo rooms.

Provision is made for the supply of energy to the lighting system and the projectors from a separate generating set; the ordinary assignment in action with one dynamo room in use would be one generating set to the lighting system and the projectors and three generating sets in parallel on the power system. The arrangement of main switchboards will, however, permit the operation of any or all generators in either dynamo room in parallel on the entire ship's load. On ships so powered as to occasion the assignment of generating sets of 50-kw capacity or less to the lighting system, it has been the custom to make provision for supplying the projectors from a generating set independent of the lighting system; but in the present instance any generating set is of ample capacity to handle the combined lighting and projector load. As the power required by each projector is less than 10 per cent. of the capacity of a generating set, several projectors could be thrown in circuit simultaneously without causing a material "dip" in the intensity of the incandescent illumination.

A diagrammatic scheme of the distribution is shown in Fig. 8.

Two main switchboards and two distribution boards are used. Two sets of feeders, one for lighting and projectors, the other for power, are run from each main switchboard to each main distribution board. In general, the forward distribution board supplies all circuits forward of the amidship portion of the vessel, and the after distribution board all circuits abaft the amidships portion of the vessel.

Under normal conditions during action, each distribution board will be energized only from its adjacent dynamo room; but in the event of one dynamo room being put out of commission, throw-over switches on its adjacent distribution board will enable this distribution board to energize from the other dynamo room. This provision permits the operation of every electrical auxiliary aboard the ship, although either dynamo room may be out of commission.

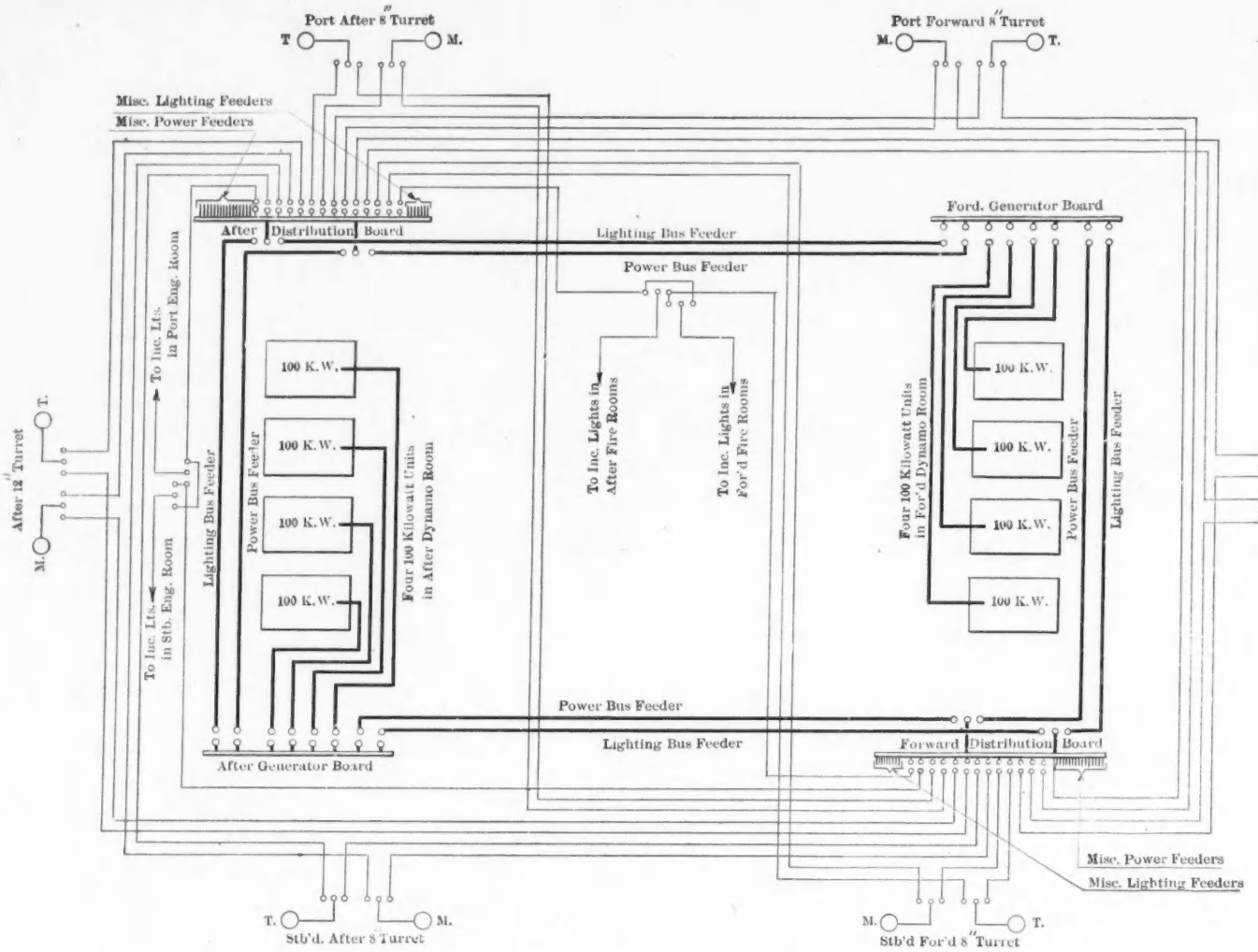


FIG. 8.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

As a further safeguard, the feeders for certain of the circuits which are of maximum importance during action will be wired from each distribution board with a throw-over switch on the far end of each feeder, i. e., at the locatioin of the auxiliary which the feeder supplies. This arrangement permits the operation of these auxiliaries even with one dynamo room and the adjacent distribution board out of commission, or with one dynamo room the remote distribution board wrecked, the latter case, however, being highly improbable.

The turning motors of each turret are, as stated previously, operated from a motor generator located in the turret barbette, the motor generator for each turret being supplied and controlled from a panel located in the barbette, this panel containing a throw-over switch and wired with a feeder to each distribution board, as outlined above.

As heretofore stated, each turret is equipped with two ammunition hoist motors, two gun-elevating motors, two rammer motors, and two small smoke-blower motors. These various motors are

supplied from auxiliary distribution boards located one in each turret, these boards in turn being supplied with a throw-over switch and wired with a feeder from each distribution board.

The incandescent lights in the engine rooms are wired from two mains, one for each engine room. By means of throw-over switches and a feeder from each distribution board, the lights in either engine room can be supplied from either distribution board. A similar arrangement is provided for lighting the boiler spaces.

All other circuits are wired to but one distribution board, the forward distribution board controlling 41 circuits, this number including one-half the circuits which are wired with duplicate feeders as outlined above. Of these, 9 circuits are for lighting, 3 for searchlights, and 29 for power. The after distribtuion board supplies 42 circuits, 8 on lighting, 3 on searchlights, and 30 on power.

The dynamo leads from the generating sets to the generator will be of 1,200,000 cm run in two cables of 600,000 cm each. The lighting feeders, running from each main generator board to each distribution board will be of 1,000,000 cm each. The power feeders from each main generator board to each distribution board will be of 3,000,000 cm each, run with three 1,000,000 cables.

Generator switchboards located one in each dynamo room and controlling the four 100-kw units in that dynamo room will each comprise a generator panel, a power feeder panel, and a lighting feeder panel. The generator panel will be so arranged that all the apparatus for controlling each unit will be in a vertical line and will consist of a single-pole circuit-breaker, a voltmeter, an ammeter, field regulator, a single-pole switch permitting the connection of one lead of the machinery to the lighting bus-bar, a similar switch for connection to the power bus-bar, and a switch to the common negative bus and a switch to the equalizer bus. The lighting feeder panel will contain a recording ammeter, to measure the entire load on the panel, the feeders, one to each distribution board, each leading through double-pole switches and circuit-breakers. The power feeder panel contains similar apparatus, but of the requisite capacity.

With the exception of certain through leads in the lower passages, the entire installation will be wired in steel enameled conduit. Wiring between generators and switchboards within the dynamo rooms, and the through leads mentioned above will be installed on porcelain insulators, metal strapped and secured direct to hull.

All wire of and under 60,000 cm will be twin conductor; sizes in excess of 60,000 cm will be installed as single conductor, a separate conduit being used for each leg of a circuit.

The installation, exclusive of interior communications, will require approximately 40,000 ft. of conduit weighing 55,000 pounds, and 44,000 ft. of wire weighing 27,000 pounds.

Generally speaking, there remain the following types of apparatus now aboard ships for which steam drive is in use and to which the application of the electric drive is feasible: (1) Steering gear, (2) main engine pumps, (3) ash hoisting machinery, (4) forced draught blowers.

An experimental installation for an electric steering gear is now under way. This consists of a motor supplied with a magnetic control, the same being identical with that now employed commercially with success on many elevator installations. The control will be operated by an attachment to the present type of steam steering gear. The same wheel and wheel ropes will be used as for the steam steering gear. The motor when started will automatically cut itself out of circuit when the helm has been brought over to the desired position. Should this device prove satisfactory, and if the helmsman can be trained to dispense with the time-honored "wheel," we may yet find an apparatus similar in appearance to the familiar street car controller occupying the position of honor in the pilot house and conning tower.

The writer is not aware of any marine installation of electrically-driven main pumps, either in our navy or in the domestic commercial marine. Such an installation has been carried out on a naval vessel built in this country for a foreign power, and has given fair success. It is hoped that this feature will eventually become more popular.

As for ash hoisting machinery and forced draught blowers, the similarity of these auxiliaries to other features aboard ship in which the electric drive has proved an unqualified success is so marked as to warrant the prediction of an early consummation of that which is devoutly to be wished.

That conservatism should predominate in the selection of an apparatus for naval installations is but a justifiable course, and the advocators of new devices and "radical improvements" for the naval service should bear in mind that a battleship is not the place for experimental work, but rather the place for the application of steadfast ideas which have been tried and not found wanting.

Recent Electrochemical Developments.

POROUS DIAPHRAGM FOR ELECTROLYTIC CELLS.

For many electrolytic operations it is necessary to hold the anodic and cathodic departments separated by porous diaphragms in order to prevent any reaction between the anodic and cathodic products of electrolysis, as such reactions mean decreased efficiency of operation. These diaphragms are a detail of great importance and their construction is often very difficult, as they must be at the same time durable, of low electrical resistance and of sufficient density to prevent the solutions from mixing.

A patent was granted on August 4 to Dr. E. A. Byrnes, of Washington, D. C., for improvements in the construction of such porous diaphragms. Many substances of high specific conductivity afford a body of low conductivity when finely divided; such a poorly-conducting granular body may be used as diaphragm, the size of the grains depending on the requisite porosity and conductivity of the diaphragm. These grains may either be mixed with an inert binder (like silicate of magnesium or calcium or ferrous hydrate) and molded into a self-supporting diaphragm, or they may be used without binder and are then enclosed between perforated metal sheets, if used for a vertical diaphragm. For cells with a horizontal cathodic surface a floating diaphragm may be employed. For the electrolysis of brine with a mercury cathode, the inventor places a sheet of amalgamated copper or iron wire gauze upon the mercury, and upon this wire gauze rests the granular diaphragm. In the same way in the electrolysis of molten sodium chloride with a molten lead cathode, the latter is covered with a wire gauze on which the diaphragm rests.

The diaphragm material should be inert toward the electrolyte and its products. For the electrolysis of alkali chlorides and nitrates, whether in solution or fused, diaphragms of magnetite or ferroferric oxide are suitable; ilmenite or chromite are also available. Broken glass or porcelain are suitable in aqueous electrolytes. For the electrolysis of molten sodium chloride with a molten lead cathode, a diaphragm of broken magnetite is suitable. For the recovery of metallic sodium from any of its molten compounds, the inventor proposes to fill a metallic vessel which serves as anode nearly entirely with granular material, a well being maintained at the top by means of a perforated cup placed around the cathode. The sodium rises and floats upon the surface of the electrolyte in the cathode well.

BATTERY INVENTION.

Six patents were granted on July 28 to Mr. Henry Halsey, of New York City, for details of construction of primary batteries, The main feature is the not very novel idea of the use of a small electric motor in connection with each battery of cells for setting up a circulation of the electrolyte. By suitable gearing the motor either revolves one of the electrodes or operates some kind of stirring device to hold the electrolyte in constant motion, in order to bring continuously fresh electrolyte to the neighborhood of the electrodes and thus prevent polarization. This is a return to the well-known principle which, previous to the introduction of the dynamo, was applied in an attempt to utilize the primary battery in lighting and motor work.

A patent was granted on July 21 to Mr. Daniel Drawbaugh, of Eberlys Mill, Pa., well known in telephone litigation, for a dry cell for which as a principal advantage the cheapness of the materials used in it is claimed. The cell has an outer cylinder of zinc, which is one electrode; next to it comes a cylindrical layer of a composition of concentrated caustic soda, with a small amount of plaster of paris or hydraulic cement; then comes a cylindrical diaphragm of paper or other porous material, and in it a pasty composition of coke, plumbago and a small quantity of plaster of paris is contained. In the center of this mass is a carbon rod which forms the other electrode. The cell is sealed at the top by means of a layer of melted pitch or tar.

A patent was granted on July 28 to Mr. David L. Winters, of Chicago, Ill., for details of construction of the terminal connections in galvanic batteries, as used for operating the spark coils of explosive engines or for similar purposes, in order to enable one to change rapidly and readily the number of cells in active use.

Telephone Exchanges.—VIII.

By Arthur V. Abbott, C. E.

THE DIAPHRAGM.

THE office of the diaphragm is to vibrate under the impulsion of the changing magnetic field produced by the line current, and by its motion to create the sound waves that shall convey to the listener the words spoken at the transmitter. The diaphragm must, therefore, be considered from two points of view: its ability to respond to field changes, or its magnetic properties; and its ability to produce sound waves or acoustic properties. Its magnetic qualities, at least from the standpoint of the prevailing notions of the magnetic circuit, have been considered, but it remains to examine such experimental evidence as exists that may tell for or against this theory. Unfortunately, such experimental evidence, at least so far as it exists outside the private archives of various receiver makers, is exceedingly meagre.

In 1878 Dr. C. J. Blake described before the Society of Telegraph Engineers (British) a series of experiments on the vibration of the diaphragm, and exhibited curves drawn on smoked glass, showing an excursion of the diaphragm of .02 mm., which seems a large value. In 1882 Salet describes in *Compt Rendus* a similar study, but only shows a vibration amplitude between .0002 mm and .0003 mm. The next investigation was by Fröhlich, published in *La Lumineré Electrique*, in 1887, who found a maximum amplitude of .035 mm. In the *Elektrotechnische Zeitschrift*, of 1890, Franke describes an investigation and concludes that an audible sound could be produced by a diaphragm vibrating .00000012 mm. Probably the most carefully conducted study is that made by Messrs. Cross, Williams, Hayes, Mansfield and Phillips during 1888-1893 at the Rogers Laboratory of Physics, the results of which appeared in the *Proceedings* of the American Academy of Science. Some of the conclusions of these investigators are here summarized.

The apparatus used consisted in a magnetic system composed of a round bar of soft iron carrying a coil of wire connected to a battery, rheostat and ammeter, whereby any desired magnetomotive force could be produced, and a magnetometer with which the actual magnetism developed in the bar could be measured. On the end of the magnet thus formed a coil of fine wire was placed that represented the line coils of the ordinary receiver. To produce the line current an alternating-current transformer, having a frequency within the common range of vocal sound, was employed in some cases, and a powerful transmitter in others, but in all tests the line current was measured with a dynamometer or milliammeter. An exploring coil was also provided so that the results of the motion of the diaphragm

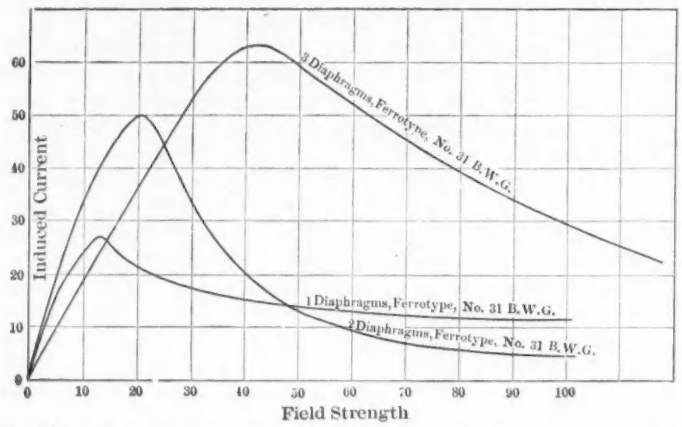


FIG. 26.—RELATION BETWEEN STRENGTH OF FIELD, THICKNESS OF DIAPHRAGM AND INDUCED CURRENT; FERROTYPE DIAPHRAGM.

in producing electrical waves could be measured by another dynamometer. Finally in front of the magnet a means for holding diaphragms was contrived so arranged that the different sample diaphragms to be tested could be held rigidly at any desired distance from the pole. The apparatus was so designed that the diaphragm could be suddenly mechanically vibrated a definite amount by a falling weight, and thus its action in producing an induced current in the exploring coil measured, also by a microscopic micrometer, the movement of the diaphragm under the action of any desired line current could be measured. By this means the apparatus could be operated either as a *transmitter* (an electromagnetic one) or as a *receiver*.

The first set of tests was made by using the apparatus as a transmitter. The diaphragm was of ferrotype metal .01 in. thick and 2 and 5/16 in. in diameter, set .03 in. from the pole, which by means of the falling weight could be given a vibration of about .01 in. The exciting current of the magnetic system was varied, and the electrical impulses produced in the exploring coil measured. The results are shown by curve 1 (Fig. 26). As the field strength increased from 0 to 14, the induced current rose rapidly to 28, then declined to about 11 and thereafter remained nearly constant. Unfortunately the scales of these results are arbitrary ones and no data is given by which to correlate them with the units now used in connection with

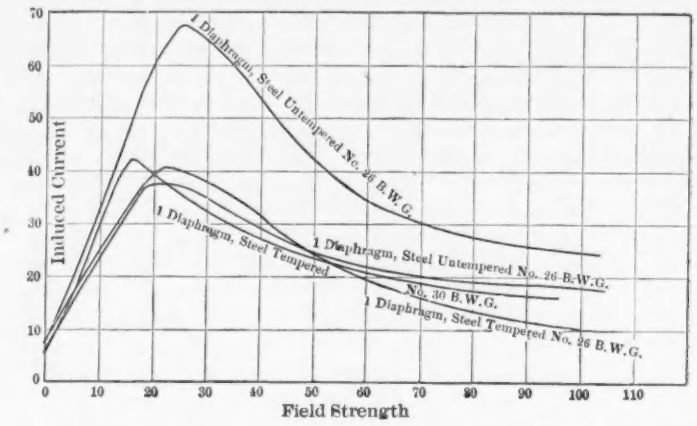


FIG. 27.—RELATION BETWEEN STRENGTH OF FIELD AND INDUCED CURRENT; DIAPHRAGMS OF SOFT AND HARD STEEL.

the magnetic circuit except that the induced ordinate 100 corresponds to a discharge of about .00000097 coulombs. But nevertheless curve No. 1 shows very plainly that the maximum reaction of the diaphragm takes place in a field that is quite weak, and that as the greatest range of action is a very narrow peak, much care is needed to proportion the field to the diaphragm to secure the best results. Curves 2 and 3 are plotted from similar tests made by using respectively two thicknesses, and three thicknesses of No. 31 B. W. G. gauge ferrotype metal in place of one. In each test the shape of the curve is the same; a sudden rise to a high peak and a slower decline. The relative ordinates measuring the current induced, and the relative field strengths at which the maximum ordinate occurs are very nearly proportional to the diaphragm thickness; so nearly as to be well within the range of probable experimental error. These curves teach that it is the relative magnetic saturation of the diaphragm that controls the line impulse given by its vibration. The thicker the diaphragm, the stronger the field may be, and the greater the impulse, both of the quantities being almost directly proportional to the thickness of diaphragm, finally the necessity of an accurate proportioning of field to thickness is most clearly shown, with the inference that there is a much greater margin in which to work with thick diaphragms than with thin ones.

To further demonstrate the effect of the permeability of the diaphragm trials were made with diaphragms made of steel, both soft and hard. In Fig. 27 curve *I* shows the relation between strength of field and induced current with a diaphragm of untempered steel No. 26 B. W. G. in thickness. No. 26 is 180 per cent. as thick as the No. 31 gauge diaphragm of Fig. 26, hence the maximum ordinate of induced current is higher, reaching 68, but the field strength is 25, against 13 of Fig. 26, showing, as would be expected, that a larger magnetizing force is needed with a less permeable material. The curve, though, is the same shape, but broader, because for steel there is no such sharp bend in the B-H curve as in iron. Curve 2 gives the results on a hardened diaphragm of the same thickness. The peak of the induced current ordinate has fallen to 42, and the field strength to 17. With the decrease in permeability that accompanies tempering, the induced current ordinate would be lower, but it would also be expected that the subsequent portion of the curve would fall off less rapidly than in the case of soft metal, as the B-H curve for hard steel shows no marked saturation point. Such, however, is not the case, for the curve closely resembles in shape those from iron of No. 31 B. W. G.

The curves of Fig. 26 show the results obtained by superimposing two and three thicknesses of iron, one upon the other in making up the diaphragm, but evidently such a mass of separate laminæ would be quite non-uniform, and one might well be distrustful of results.

In Fig. 28 further tests on diaphragms of sheet iron of a number of different thicknesses are given, but here each test is for a solid sheet, and the material is somewhat more permeable than ferrotype metal. In all respects the results are confirmatory of the deductions of the previous tests, and taken in connection therewith form a valuable mass of data well worthy of careful study by those who design and operate receivers.

In the preceding investigation the apparatus was used as if it were a transmitter, for a vibratory impulse was given to the diaphragm, and the resulting electric pulse (as a momentary line current) measured. The conditions were then reversed, a small current, representing a wave from a transmitter, was sent through the line coil, and the effect, as an induced current measured by the exploring coil. In the first trial no diaphragm was used. The results are shown by curve *B*, Fig. 29. The field strength was varied from 0 to 120, electric impulses of constant amount sent into the line coil and the effect on the exploring coil measured. With no diaphragm the induced current commenced nearly at a maximum of 102, remained nearly constant till a field of 20 was reached and then steadily declined. Such a result would be anticipated from the general appearance of a *B-H* curve for very weak fields, for the relative magnetizing effect of a small increment of current is much greater with a weak field than with a strong one. A diaphragm of No. 31 B. W. G. sheet iron was then added and the effect is shown by curve *A*. Here the induced current increased markedly from a field of 0 to one of 10, and then drops with a decidedly greater slope. | The lowest curve in Fig. 29, marked *A B*, is the difference between curves *A* and *B*, and shows the effect on the induced current of the presence of the diaphragm, by introducing into the field a substance of greater permeability. The test apparatus, as is readily seen from the description, was similar to a *single* pole receiver, having an air-gap equal to the length of the magnet. It is to be regretted that similar trials were not made with a double-pole type when the presence of the diaphragm would be expected to produce a much more marked effect. Many experiments on diaphragms of different thicknesses were made, those for Nos. 22, 23 and 26 being reproduced in Fig. 29. An examination of these curves show that the induced current rose in value as the diaphragm was reduced in thickness, also that the strength of field simliarly increased. A careful examination of the results shows the following values:

Thickness.	Induced current.	Field.
21	131	6
22	132	10
23	137	13
26	142	18

With thin diaphragms the slope of the curve is more rapid than with thick ones, showing a narrower margin with thin diaphragms. Probably the explanation of the greater value of the induced current with thin diaphragms lies in the fact that they are less rigid and move a greater distance in the field with a given change in the line current, thus causing more lines of force to cut the exploring coil.

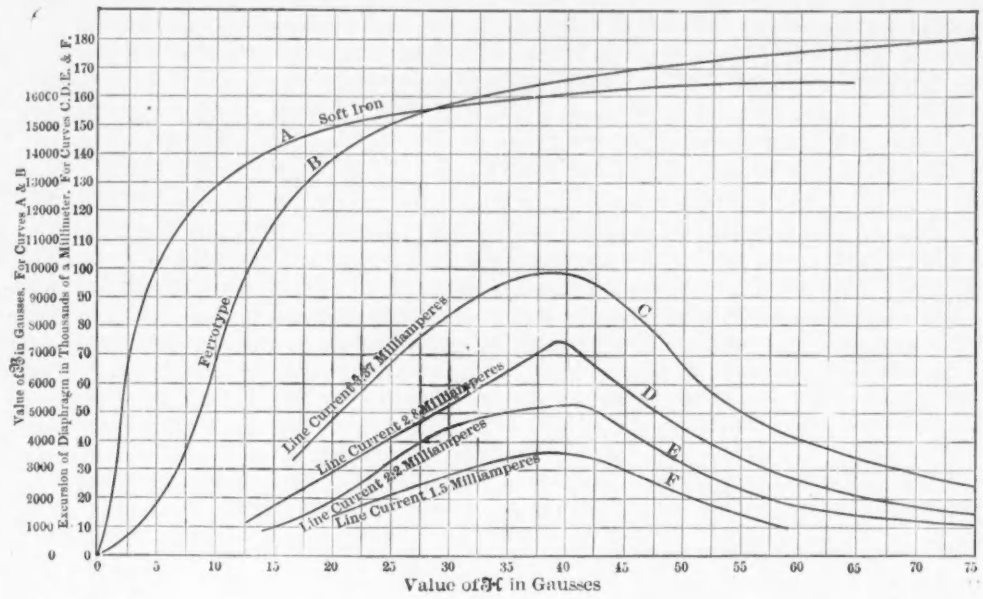


FIG. 30.—RELATION BETWEEN STRENGTH OF FIELD AND MOTION OF DIAPHRAGM WITH VARYING LINE CURRENTS.

The foregoing tests determined the relation between strength of field and induced current produced by a predetermined mechanical movement of the diaphragm, also strength of field and induced current produced by a predetermined line current impulse. It now remains to ascertain the relation between strength of field, and

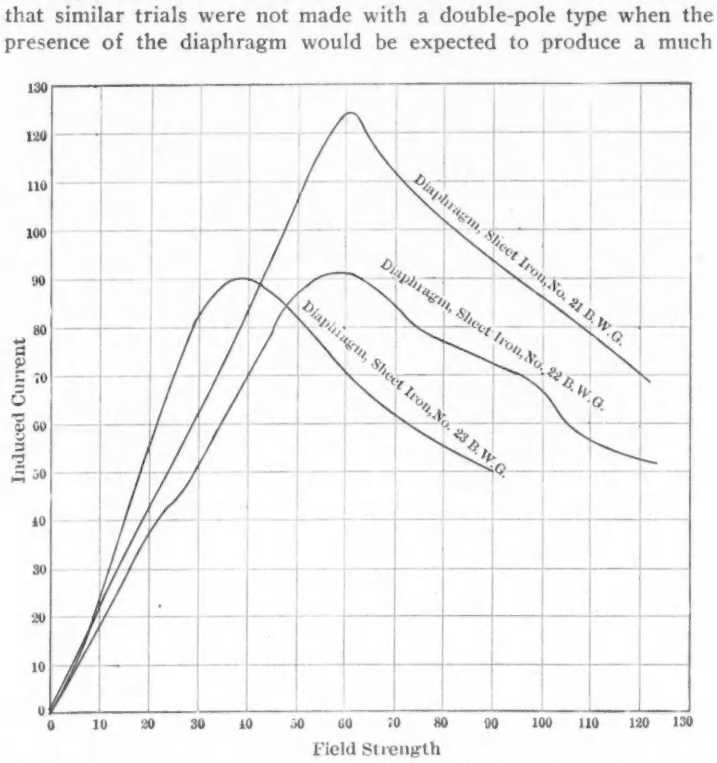

Induced Current
Diaphragm, Sheet Iron, No. 21 B.W.G.
Diaphragm, Sheet Iron, No. 22 B.W.G.
Diaphragm, Sheet Iron, No. 23 B.W.G.
Field Strength

FIG. 28.—RELATION BETWEEN STRENGTH OF FIELD AND DIAPHRAGMS OF VARIOUS THICKNESSES OF SHEET IRON.

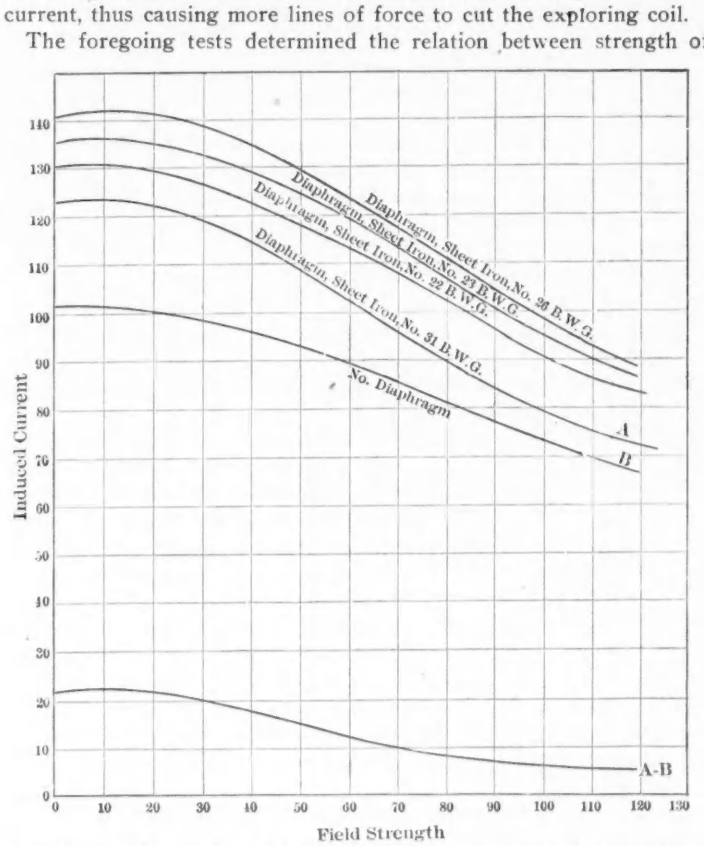


FIG. 29.—RELATION BETWEEN STRENGTH OF FIELD, INDUCED CURRENT AND THICKNESS OF DIAPHRAGM IN A RECEIVER.

resulting mechanical motion of the diaphragm, with line impulses of varying intensity. The apparatus was similar to that already described; the same diaphragm being used in all tests, set 1-32 in. from the magnet. The line currents were produced by a powerful microphone transmitter, excited by an organ pipe blown by a carefully regulated air blast giving a pitch C_3. In Fig. 30 the inside scale of the vertical axis gives the moment of the diaphragm in thousands of a millimeter, and the horizontal scale the strength of field. In these tests the ampere-turns of the magnetizing coil are given, so it is possible to plot the field in gausses, which has been done. Four curves are shown, *C, D, E* and *F,* in which the line current was respectively 3.37, 2.80, 2.20 and 1.5 milliamperes. These curves teach four things: First, as the field increases the excursion of the diaphragm increase to a maximum and then decreases to a nearly constant quantity. Second, The maximum excursion ordinate occurs at about the same point for all line currents. These two results would be anticipated from the previous test, and the fact that the same diaphragm was used, placed at the same distance from the magnet. Third, the excursion of the diaphragm varied with the line current and was nearly proportional thereto, for if the line currents be represented by 1, 1.46, 1.87 and 2.24 the excursion will be represented by 1, 1.47, 2.08 and 2.72. Fourth, the maximum excursion was found in a field of about 40 gausses. For comparison, a B-H curve for soft iron, from Ewing, and one for ferrotype metal, from Steinmetz, are plotted on the same sheet. The soft iron is more permeable and earlier saturated, but with a field of 40 the ferrotype shows an induction of 16,600 lines. These results confirm those which precede, and supply the additional numerical data that a ferrotype diaphragm to give the loudest sound should be set in a field of about 40, provided its thickness is such as to give an induction of 16,000 gausses.

The "Production Engineer" and Electricity.

By Howard S. Knowlton.

THE stoppage of leaks in the operation of modern industrial organizations is receiving a great deal of attention these days, so much so in fact, that it has given rise to a new and highly specialized profession—"production," or "modernizing" engineering. Thus far the published records of this new work point chiefly to triumphs gained in manufacturing plants of one kind or another, improvements in processes, methods of cost keeping, sequence of operations, replacement of old machinery by new designs, and such like. That the field of electricity, almost boundless in its variety of applications, offers signal opportunities to the experts in this new branch of applied economies, no one can doubt, if his opinion is of even average intelligence.

The qualifications of a production engineer are so peculiar that he can best be described as a civil, mechanical, electrical and industrial engineer rolled into one, and held in place by a strong endowment of common sense coupled with business ability. Above everything else he must possess the microscopic eye for all forms of waste, and must have in his makeup an insatiable hunger for the elusive losses which abound in industrial life. The sight of two men doing the work of one must move his soul to tears, figuratively speaking, and the presence of an uncovered steam pipe must stimulate his powers to expression in pointed recommendations. He must be an apostle of scientific laziness—if laziness means getting things done in the easiest possible way.

Practically every electrical enterprise of consequence is managed through an office. The chances of leaks here are numerous, but only a few can be mentioned, as an electrical office is run in pretty much the same way as any other. It is now generally realized that small savings go a long way toward furnishing the profits of any business.

One of the first points about an office which occurs to the production engineer is the possible slipshod treatment of the correspondence. In all large concerns, a mailing department is a necessity which should not be omitted, and whether the company has many or few correspondents it should always be possible to immediately locate any letter or copy of a letter which has been received or sent. According to the circumstances of the case, the production expert will thoroughly reorganize the whole system of correspondence and data filing, if he finds it defective. Thus one firm may be led to paste a numbered slip upon each letter or telegram which it receives, stamp upon it the date of reception and the correspondent's number, and in a suitable blank space add the name of the department which is to receive the communication. The work of the mailing department will be completed by recording in a ledger or card index these essential features, and sending it to the particular department to which it is destined. The correspondence clerk of the latter section of the office then stamps the slip with the receiving date of his department and then refers it to the proper employee, first dictating an abstract of its contents to a stenographer, and then passing it to the subordinate through the head of the department. These abstracts may then be typewritten on daily sheets constituting a diary of inward letters, and be most valuable for quick reference.

After the original letter has been answered or disposed of it finds its way into the department filing case. Whenever the volume of business permits, the department head should read the original letter, and in any case, its summary, in order that he may be fully posted as to all the important events which concern his subordinates. When letters are sent out by an employee of a department a copy should always be sent to the department files, and a summary of its contents dictated for an "outward" letter diary. Some firms also take a letter press copy of the final signed letter in the mailing division before it goes out, as an additional check against loss. It is better to refer a copy of the original letter to various people in a large office than the letter itself, in many cases. The time-saving advantages of this system are very great where correspondence is heavy. Of course circumstances vary so much that a good many different systems of filing letters are to be considered before any one is adopted in a particular case, but the foregoing is a suggestion as to the method of the production engineer in the practice of large consulting firms, and is only intended to hint at what may be done. While it is true that an office which spends so much time on letters as is demanded above seems trussed up with red tape, it will be found in actual experience that letters may be located and noted with remarkable speed and accuracy, especially by the aid of the inward and outward diary. The work on the letters is done once and for all when they arrive, and after that it is a simple matter to run through them, actually or by reading the abstracts.

The filing of data is a source of considerable trouble in many concerns. Experience seems to show that no single form of recording device is satisfactory in every case. Generally, some form of card catalogue or drawer file, or removable leaf note and record book fills the bill with tolerable success. In electric railway lighting or power transmission work the card index finds a firm foothold. If the production engineer is to take the drafting department in hand, he will usually insist that every drawing made be recorded on tracing cloth if possible, and numbered, with the date plainly added. There will then be a card index of drawings close by the department chief's desk, with each drawing recorded under its subject title, and a cross reference to its number.

Sometimes it will be found that the employees are using the company's correspondence paper for rough calculations, instead of the cheaper grade which may be provided. There is not always an acute moral sense of the right and wrong of using the company's stamped envelopes, unpaid for—and again, traveling expenses sometimes are lumped in sums which cover a multitude of experiences. Even the use of the company telephones may be abused by clerks who take such occasions to discuss subjects about as far from their proper business as is the moon from Monte Carlo. It would surprise most of us if the sum total of time spent by employees in personal telephone talks during one week could be placed before our eyes for a single large office. All such considerations fall under the observation of the production engineer, and it is safe to say that no detail is too small to be worthy of his attention.

Passing now to the more technical phases of electrical work, we find the modern electric power house to be as full of interest to a modernizing expert as any factory. Here the raw material is first handled at the coal barge or car, and in all the steps from storage bin to switchboard, losses occur which may well be an incentive to the production engineer's highest saving ability. In his study of a great modern plant he must enlist the aid of trained steam, mechanical and electrical engineers—and it is possible, even probable, that in some of the latest designs he will find nothing which he is able to improve. In the vast majority of cases, however, there will be suggestions to make, which will mean greater economy in operation. Thus, in a dark corner there will be a steam pipe whose covering is decayed, in another place a small door cut through the wall will save time, here the coal scales are in an inconvenient place,

and perhaps inaccurate as well, and there the high-tension wiring sags, too near the steel framework of the building—all sources of waste or possible loss.

A thorough study of a power house from such a standpoint means an enormous amount of work. It means more than one day of the keenest observation of every detail of operation. It means the close study of pages on pages of the station record book, reports, records of coal consumptin, water supply, energy output, etc. Everything must be reduced to the unit basis—cost per kilowatt-hour—and graphic diagrams, the slide rule and every possible aid utilized. The processes whereby the potential energy of coal or falling water are finally transformed into electricity are probably as complicated in detail as the processes of many factories whose products are material and visible. Even the very switchboard instruments must be distrusted, just as the production engineer is obliged to distrust the count of a factory's product until it is proven correct.

Transmission and distributing systems open up a field of wide research for the modernizing expert. Even granted that the original design was adequate to the demands of the system in hand, it is always worth while to consider what the status of affairs is after time has gone on and joined the installation to those of the past. Certain it is that many an overhead and underground system is carrying ruinously heavy loads, thus wasting energy which costs money, and is giving poor service to boot; and also it is true that street railway systems may be found in some of our large cities literally overburdened with tons of useless copper, whose fixed charges are eating into the net earnings with no uncertain appetite. To discuss the prevention of fires caused by defective installations of electrical apparatus would lead us into the specialized branch of fire insurance engineering, which is beyond the scope of this article. Suffice it to say that the production and the fire insurance experts walk in the same path as far as loss saving is concerned. The protection of human life by careful wiring, liberal switchboard provisions and the elimination of dangerous features in belting, from prime-movers to generating machinery, all fall within the scope of the modernizing expert.

In the field of operation of electric railway, power and lighting systems the production engineer is in his element. Looking as he does upon a railway as a great machine for the manufacture of transportation, every detail of operation settles into his mind in the order of its relations to the process as a whole, and as a result every defect which can be eliminated may be the means of a financial saving. Thus the handling of trolley cars may invite accidents, and consequent heavy money damages and loss of public goodwill, and its improvement, a saving which cannot be directly calculated. Similarly in lighting and power systems small savings and improvements lead to great economies.

Telephone and telegraph work, electrochemical processes, the manufacture of electrical machinery and the varied applications of storage batteries—these and many other details of electrical industries offer tempting opportunities in business or operating improvements—but as this paper has already outgrown its intended length, the foregoing suggestions will probably be enough to show that among all the fascinating kinds of work which a production engineer can undertake, few if any offer greater opportunity for usefulness than the elimination of wastes at present accompanying the extended applications of electrical energy in modern civilized life.

Combined Gas Engine and Electric Equipment for Automobiles.

The idea of the use of a gas engine as prime-mover on an automobile and the provision of an auxiliary electric equipment intermediate between the gas engine and wheel is not new. An automobile of this type was first built in Europe three or four years ago. At first sight this combination looks rather complicated, but actual tests have shown that it has distinct advantages. The gas engine runs continually at constant load and the electrical equipment offers all the advantages of the flexibility of electric power transmission. A new solution of this problem has been found and has recently been patented by Justus B. Entz, of Philadelphia.

The problem may best be explained by resolving it into two parts. The first is to provide some sort of automatic changeable ratio gearing between the gas engine and the wheels, so that the constant work performed by the engine is represented by a high driving effort at the wheels, together with slow speed when the automobile climbs a hill, and by a low driving effort and a high speed on horizontal road. In other words, the constant horse-power of the engine manifests itself in varying speed and driving effort, and this variation adjusts itself automatically to the condition of the road and to the steepness of the hill which the automobile climbs at any moment. This automatic changeable ratio gearing is provided in the form of the following electric equipment:

On the axle of a pair of wheels the armatures of two electric dynamos are mounted. The field of the first dynamo is driven by the gas engine; the field of the second dynamo is stationary and its exciting current is automatically controlled by a rheostat which is operated by a governor on the engine. The circuits of the two armatures are in series. It is evident that with this arrangement, in which the gas engine furnishes all the power, and in which it runs under conditions of constant speed and constant rotary effort, greater driving effort on the wheels is obtained at the expense of speed. Thus the speed is fixed for any given condition of grade and can only be increased by the addition of power in excess of the power of the engine, and can only be decreased by diverting some of the power of the engine from the driving shaft of the wheels.

This is the second problem and its solution is rendered easy by the intermediate electrical equipment. As mentioned above, the circuits of the two armatures are in series. To increase or decrease the power transmitted from the gas engine to the wheels, it is, therefore, only necessary to insert a storage battery in the circuit of the two armatures; when it discharges it adds power to that of the engine; when it is charged it consumes part of the power of the engine. The gas engine gives continually the average power required at the wheels, and the regulation at any moment to accord to the instantaneous condition of the road, is obtained by including, with the aid of the controller, any number of cells of the storage battery in either direction in the armature circuit.

CURRENT NEWS AND NOTES.

THE METRIC SYSTEM.—An illustration of the length to which opponents of the metric system will go in their blind fury is a statement made before a meeting recently in New York of the Furniture Association of America, namely, that "In France, the country in which the system originated, it is in practical disuse." Anyone who has lived even a short time in France knows how absurdly false is this statement. The press agent of the metric opposition, who brought up the question before the meeting, had the field to himself and was enabled to secure the passage by the furniture men of a resolution condemning the metric system.

CABLE-LAYING NAVIGATION.—In the current issue of the *Proceedings* of the United States Naval Institute, Lieut.-Commander John B. Blish, U. S. N., formerly in technical charge of naval electrical work, gives an interesting account of the refinements in navigation practiced on board cable-laying ships. Aboard the cable-laying steamer *Faraday*, in which Mr. Blish took a trip, no less than nine experienced navigators took sights from early dawn until dark, and half-hourly azimuths. All sights were worked out with seven-place logarithms, and a mean of the various positions was accepted after throwing out any which differed a mile from the mean. Among the navigating appliances was a "distance wire," consisting of a deep-sea sounding wire (No. 20 B. W. G.), which was paid out continuously under a carefully regulated strain, and passing over a measuring wheel recorded the run with an accuracy comparable to that of measuring distances in land survey. Dead reckoning was computed from distance wire records. Notwithstanding the skill of the navigating staff, the exact position of the ship was at times in doubt, owing to uncertainty as to the actual dip of the horizon. This experience led to the invention by Mr. Blish of a navigator's prism, which is described in detail in the paper here referred to. By means of this device the dip of the horizon can be determined with great accuracy, thus eliminating a treacherous element of uncertainty in observations at sea.

SUBMARINE CABLE OWNERSHIP.—According to recent statistics on the telegraph lines of the world, published in Berlin, Germany owns 10,220 miles of telegraph cable, or one-twenty-fourth of the entire system of the world, while Great Britain owns two-thirds of the total mileage.

HERTZIAN WAVES IN NAVIGATION.—In a recent patent Hermon W. Ladd describes a means for using Hertzian waves in obtaining bearings at sea when the objects owing to a fog or storm are invisible. This consists of a coherer circuit electrically connected with an upright conductor so shielded that waves are only received from a transmitter on another vessel or at a shore station when a lateral opening of the shield is in proper range radially with the vessel or station. The shield is movable and at its lower end has a pointer moving over a compass card. When the coherer in circuit gives a signal, the range is determined.

INSULATED RAIL JOINT.—A patent was recently granted to John D. Keiley, of New York City, for an improvement in the insulation of the base of rails from the rail chair. Beneath the base of at least one rail two layers of insulating material are arranged; the one next to the base of the chair is of mica material or a sheet of mica, while the other layer, above the former, is thicker, and consists of a tougher material of lower insulation, such as vulcanized fibre. The object of this arrangement is to form a soft surface or cushion for the mica material to prevent injury due to shocks and jars incident to constant traffic over the rails. Another patent granted to George A. Weber, of New York City, relates to details of constructing the above joint.

D'ARSONVAL ON ELECTROTHERAPY.—Electricity will be the sole medicine of the future, according to d'Arsonval. At a recent meeting of the Psychological Institute of Paris, he made an exhaustive address on "The Action of Electricity Upon Human Beings." He spoke of the sudden shocks of electricity, as well as the slow method by which it pervades the human system without the patient being sensible of it. He showed that electric treatment is excellent for certain maladies of the skin, and that electricity has a powerful effect on microbes and accelerated circulation and respiration without fatigue to the person operated on. Moreover, what is most important, it acts strongly on cellular vitality. He added that electricity will bring about a therapeutic revolution.

ELECTRICAL GAMBLING.—The following story is quoted by the *New Orleans Times-Democrat* from a recent visitor to San Antonio, Tex.: "I walked into a big gambling house and was almost speechless for a moment on seeing a number of women seated at a keno table. But I was soon told that it was a very common thing. It was in this place that the game of keno is played by electricity. Two and 300 people can play at the same time by means of the apparatus. The players are seated at two long tables on either side. At the end of the hall is a large rack which is connected by electric wires with a buttonboard or keyboard. As the dealer turns the cards, the operator touches this or that button or key, and a number falls in the rack corresponding to each key or button pressed and to the cards, as they are turned from the deck. The numbers are clearly visible to each player at the two long tables. The advantage afforded is that any number of people can play at the game at the same time. I am told that the system has proven highly satisfactory."

SPEED INDICATOR FOR INDUCTION MOTORS.—It is well known that the load of an induction motor is indicated by its slip. In some cases, especially in cotton or textile mills, a relatively slight drop in speed would produce detrimental effects, and for such purposes it is either necessary to employ larger motors with close speed regulation, or to use small motors and prevent too great a speed variation of the same by regulating the speed of the generators in the power station. The first method is expensive, the second requires the use of an instrument which indicates in the generating plant the speed of the distant motors. Two patents for such a speed indicator were recently granted to Ernst J. Berg. The frequency of the currents in the rotor of an induction motor is proportional to the speed; hence by tapping the windings of the rotor at suitable intervals polyphase currents are taken off of a frequency corresponding to the slip. These currents are transmitted to the switchboard of the generating plant, where they actuate the frequency indicator; if their voltage is too low, a step-up transformer may be employed. The frequency indicator, in the form preferred by the inventor, is a motor of the rotary field type. One member of it is fed with polyphase currents of the same frequency as that fed to the motor whose speed is to be measured, these currents being furnished from the supply mains. The other member is fed with polyphase currents proportional to the slip of the motor in the manner described above.

INSULATING MATERIAL.—The manufacture of a cheap and effective insulating material for electrical purposes is still a promising subject for chemical research. The difficulties involved in the solution of this problem were recently pointed out by Dr. M. von Recklinghausen in an American Electrochemical Society paper in which he defined the desirable and undesirable properties and gave some indications as to the direction in which researches should progress in future. The number of patented insulating materials has recently been increased by a new one of comparatively simple composition, the invention of F. Basenan and A. Cohen, of Amsterdam, Netherlands, and consists mainly of asphalt and petroleum. Of prime importance is the purification of the asphalt, by which all malodorous constituents, especially the volatile sulphur compounds, are removed. For this purpose the asphalt is maintained for some days at a temperature, exceeding its melting point, with the exclusion of air. It is then mixed with a smaller or larger quantity of petroleum, according to the desired flexibility and hardness of the final material. While the petroleum which has been raised to the same temperature is mixed with the melted asphalt, a solution of alumina hydrate in acetic acid is added under constant stirring, and finally some colophony or other suitable resin and alkali is added. These additions cause a violent frothing of the whole mass, whereby an intimate mixture of the materials is produced. The addition of the aluminum aceticum imparts to the material great toughness, while the addition of resin and alkali renders the petroleum semi-solid or gelatinous. The mass is maintained in a decidedly liquid condition by heat under continuous stirring and is subsequently allowed to cool. For the jet black product, thus obtained, the following claims are made: It softens at a moderate temperature, about 70° C., and hardens again rapidly on cooling; it is very flexible, possesses a very high electrical resistance, and is not attacked by strong hydrochloric or acetic acid, dilute nitric or sulphuric acid, ammonia, alkalies and ordinary or salt water.

COOPER HEWITT VAPOR LAMP.—Three patents were recently granted for improvements in details of construction of the Cooper Hewitt lamp. A detail of this lamp is a band or strip of metal near the negative electrode, which is usually called the "starting band." This is generally connected with the positive side of the circuit and its function appears to be that of developing an electric strain in the neighborhood of the negative electrode which assists in the ultimate breaking down of the negative electrode resistance. As this starting band, which is connected with the positive side of the circuit, is in rather close proximity to the lead wire running to the negative electrode, there is danger of sparking between this lead wire and the starting band. In order to avoid this sparking, Dr. Max von Recklinghausen surrounds the lead wire with a tubular extension to a point beyond the sparking distance.—For starting the lamp a main-line switch, one or more inductance coils in series with the lamp, and a snap switch, in shunt between the lamp and its induction coils, are provided. In places where a number of lamps are located near together and subject to the control of the same operator, it is sufficient to have a single main switch and a single snap switch; the latter may then be used to operate the circuit of any one of the group of lamps. For this purpose Stanwood E. Flichtner has devised an adjustable switch.—The same inventor has devised a modification of the ordinary construction of the inductance coil in series with the lamp, which is used for the initial higher potential starting current, and which is also used as the entire series resistance for the lamp during operation. It has been found, however, that in practice the resistance of these lamps increases during the first few weeks of running, so that a coil which is exactly adjusted for a certain lamp on a given voltage will, at the end of several weeks, have too great a resistance, thus causing the lamp to run on too low a current. Mr. Flichtner, therefore, uses two inductance coils in series with each lamp and provides one of the coils with such connections that one or more layers of wire may be cut out of circuit. In this way the increasing resistance of the lamp is compensated for from time to time by cutting out successively several layers of this coil.

INQUISITIVENESS BY TELEPHONE.—A Western newspaper states that a lineman inspecting a rural telephone line in Adams County, Ill., entered the home of a subscriber and found a woman knitting in a rocking chair with her telephone receiver tied to her ear. She was listening to every conversation that passed over the wire.

CABLE TO ALASKA.—A special dispatch from Seattle, Wash., of August 4 says: "The United States cable ship *Burnside* has arrived from Sitka, where she completed the preliminary work of laying the cable between this city and Alaska. She is here to take on board 600 miles of cable. A dispatch from Dawson says that after a work of months American troops have replaced most of the line destroyed by fire in Tanana Basin. Connection from St. Michael to Seattle is daily expected."

CHEAP ELECTRIC LIGHT FOR BERLIN.—An article in the Frankfurter Zeitung states that, commencing on January 1, 1904, the price of electric current in Berlin will be reduced 27 per cent.—from 55 pfennigs to 40 pfennigs (13.1 cents to 9.5 cents) per kilowatt-hour—and that the price for electric light in Berlin will then be cheaper than in any other large city. This reduction was made to compete with gas light. Details are not given as to the scale for large quantities, and the prices here mentioned are considerably beaten by the New York Edison and other American rates.

EFFECTS OF RÖNTGEN RAYS.—A cable dispatch from London of August 5 says: "Two doctors belonging to the staff of the London Hospital have been affected by X-rays in a manner similar to that of the assistant of Thomas A. Edison, and have been compelled to abandon their work. They were engaged for a long time in making examinations of and manipulating diseased parts while X-rays were directed on the patients. When they began to suffer they tried gloves in the backs of which lead foil was sewn, but these impeded the movement of their hands and were discarded. One of the sufferers ceased operating under the rays eighteen months ago, yet his hands have improved little, despite constant treatment.

TELEGRAPHS IN KOREA.—A cable dispatch from Korea of August 6 says that an agreement has practically been concluded between Russia and Korea, whereby Russia acquires 200 acres of land at Yongampho, on the Yalu River, on a ninety-nine years' lease. The application of M. Pavloff, the Russian Minister, for permission to erect telegraph and telephone lines to Yongampho has been refused. Previous dispatches said that work on the Russian telegraph line between Au-Tung and Yongampho had been abandoned in consequence of Korean remonstrances. Thereupon M. Pavloff objected to the Japanese telegraph line from Seoul to Fusan, which was constructed prior to the Russian line. The Korean Government asked the Japanese Minister to have the line removed, but the minister declined to do so.

GERMAN ASSOCIATION OF INVENTORS.—The Central Association of Inventors "Germania," of Bayreuth, will hold a general exhibition at Nüremberg during September and October of this year for the purpose of facilitating the sale of patents and copyrighted patterns. There are more than 200,000 copyrighted patterns in Germany and over 140,000 patents; one-half of these, however, are not in public use, for the reason that the inventors were not able to exploit their inventions. On account of this the Central Association was formed a few years ago. Its purpose is to assist the members to make their inventions profitable to themselves, as it is a well-known fact that a majority of inventors have not the means to do so. The association furnishes space to inventors without means free of cost and charges no fees for effecting a sale.

LONG ISLAND TROLLEYS.—With regard to the unification of Long Island trolleys noted in these columns last week, it is said that the idea that the purchase by the United States Mortage & Trust of a number of trolley lines on Long Island has been in the interest of the Long Island Railroad Company is incorrect. The deal has been made in the interest of the Interborough Rapid Transit Company, and although not formally sanctioned by the directors of this company, there is no doubt whatever that it will be approved when the proper time arrives. This development is in line with a policy of ultimate consolidation of tunnel, elevated and surface railroads in Greater New York and with ramifications practically throughout Long Island. The concentration into a few hands of a majority of Brooklyn Rapid Transit stock foreshadows something more than results expected from the inauguration of up-to-date methods by the present management on the property as it exists to-day.

ST. LOUIS FAIR AUTOMOBILES.—Last week we gave details as to the automobile chairs for the St. Louis Exposition grounds. It is stated that an organization has been formed under the name of the World's Fair Automobile Company, to operate at least 200 automobiles between the hotels and the union station in St. Louis and the fair grounds. The largest will be tally-hos, to carry forty passengers, and the smallest will be runabouts, to seat two persons. Steam, gasoline and electricity will furnish the motive power. Visitors will be taken direct from their hotels to the entrance to the Exposition or on the grounds, as the case may be. Coupon tickets will be issued entitling passengers to a ride and also to admission to the fair, and those holding such tickets will be deposited at stations provided for collecting and discharging passengers within the grounds. The automobiles will be run through the prettiest residence thoroughfares of St. Louis. It is expected that the proposed automobile service will be popular, as enabling people to reach the fair otherwise than by crowded street cars. The views of the trolley companies on the subject are not cited. The street cars will probably have all they can do.

LIGHTING A FLORAL CLOCK.—The St. Louis Exposition is to have a unique floral clock, and work has been begun by the Johnson Service Company, of Milwaukee. This mammoth clock will be installed on the side of the hill north of the Agricultural building. The dial will be a flower bed 120 ft. in diameter. The minute hand will be 60 ft. long, and the ring at the end, which will be fastened to the machinery, will be 8 ft. in diameter, large enough to support 12 men easily. A hundred persons might promenade on this hand without interfering with the movements of the timepiece. The minute hand will move 5 ft. every minute. The clock machinery will be in an adjacent building. The flower bed will be a masterpiece of the florist's art. The entire dial will be a flower bed, and the numerals marking the various hours will be 15 ft. in length, and made of bright colored coleus, a foilage plant with bright colored leaves that grows dense and may be pruned and kept symmetrical without danger of impairing its growth. In a broad circle, surrounding the dial, will be twelve flower beds, one opposite each hour, each 2 ft. wide and 15 ft. long. These collections will represent various flowers, but each will be so selected that the blossom is open at the particular hour it represents, and at no other. In this way both the hands of the clock and the flowers will tell the time of day. At night the whole vast timepiece will be illuminated with 2,000 incandescent lights.

ECONOMY OF ELECTRIC DRILLS.—Mr. John B. Hobson, general manager of the Consolidated Caribou Hydraulic Mining Company, at Bullion, B. C., in his annual report, gives some interesting figures of costs of operating an installation of electric drills. The plant included four drills with 2-hp, 110-volt, direct-current portable motors, one drill, with 1½ hp, 110-volt direct portable motor, all complete, with seven-foot flexible shafts, adjustable tripods, drifting columns, the necessary flexible cables, working tools and five sets of drills of suitable lengths to drill holes varying from two to eight feet deep. The figures are: Steam power—One cord of cedar wood, delivered, $2.25; one engineer, $4; lubricants for engine and generator, 35c.; total, $6.60. Operating three drills—Three power-drill men at $4 each, $12; three helpers at $2 each, $6; one blacksmith, $4; one helper, $2; three bushels of charcoal at 25c., 75c.; lubricants, 20c.; total, $24.95. Total cost of running three drills 10 hours, $31.55. The duty attained by drills used during the season, in advancing and lowering the bed rock cut, averaged 312 ft. of holes per 10-hour shift. The duty attained by two miners drilling by hand, with ⅞-in. steel and 8-pound hammers averaged about 14 8/10 ft. per 10-hour shift, and made the cost of drilling 312 ft. of holes in bed rock by hand, as follows: Forty-two miners at $2 per day, $84; one blacksmith at $4 per day, $4; one helper at $2 per day, $2; four bushels of charcoal at 25c., $1; total cost of drilling 312 ft. of holes by hand, $91. Saving made in favor of power drills per ten-hour shift, $59.45.

LOSS ON GOVERNMENT TELEGRAPHS.—The British Post Office figures for 1902-3 show the usual loss on the telegraph service. The telegraph revenue was £3,723,866, an increase of £153,820. The expenditure of the telegraph department was £4,317,371, a net deficit of £593,505. If allowance is made for the interest on the capital, £10,867,644, created for the purchase of the telegraphs, the deficit would be £892,365, or about $4,500,000.

DEPARTMENT STORE ENGINEERING.—It is interesting to note that the "department store trust" organized in New Jersey last week as the Cash Buyers' Union First National Co-Operative Society, with an authorized capital of $5,000,000, has among its innumerable objects that of carrying on the business of electrical engineering, associated with hair dressing, gardening, dealing in "fancy animals," printing, and other odd jobs.

AUTOMOBILE LAW.—The American Automobile Association has just issued from its headquarters at 753 Fifth Avenue, New York City, a very neat little brochure, giving the State laws affecting automobiles for New York, New Jersey, Pennsylvania, Connecticut, Massachusetts, Rhode Island, Vermont, Maine, and Delaware. The book contains text and digest. A second pamphlet will embrace the automobile law of the leading Western States.

THE POPE AT THE TELEPHONE.—One of the interesting stories sent from Rome about the New Pope, Pius X, is as follows: "Monsignor Stratimirovich, the Venetian prelate, accompanied him to Rome and up to the door of the Conclave, and, in taking leave, expressed the hope that Cardinal Sarto would be made Pope. The Cardinal replied, laughing: "No. No fear for me. Tell me the number of your telephone and I will let you know who receives that honor." In all of the excitement of his first election he kept his word and went to the telephone personally, and called up the number, only to find that Monsignor Stratimirovich already knew the result of the balloting, and was on his way to the Vatican."

INTERCEPTING WIRELESS MESSAGES.—A cable dispatch from London of August 8 says: "The French Wireless Telegraph Company has replied to Marconi's assertion that his messages cannot be intercepted by informing him that for the past six months every message sent, not only from his station at Poldhu but from any Marconi stations around the British coasts, has been intercepted by the French Wireless Telegraph Company's station at Cape de la Hague, and that copies of these messages are at his service. Marconi has not asked for the copies. When the Prince of Wales recently visited Poldhu station he asked Marconi to send a message across the Atlantic, but the inventor informed him that it would be six months before the apparatus would be ready to carry out that experiment."

BROOKLYN BRIDGE TERMINAL.—Mr. H. F. Hornbostel, designing architect employed by Commissioner Lindenthal to prepare plans for the proposed Brooklyn Bridge Terminal and city offices on Manhattan Island, has a scheme which is grandiose to a degree, involving $50,000,000 ultimately, and $9,000,000 now. A 42-story building is contemplated, with trolley loops and other tracks in the lower stories or levels. This enormous terminal station will extend up as far as Duane Street, and provides for five stories of city offices. The building will be carried out on the same architectural design as the new Hall of Records, and the plan provides for the construction of the campanile up to that level. The campanile proper, with its thirty-seven additional stories, is to be used for office purposes, and to house city departments. The full height of the campanile, as projected, will be 650 ft., giving in all 400,000 sq. ft. of office room. The cost of $9,025,825 for this terminal station does not include the campanile above the roof of the base, or a height equal to that of the Hall of Records. The cost of completing the tower would be $1,468,800 more.

TECHNICS AND ECONOMICS.—At the recent congress of the Association of German Engineers, a paper read by Prof. Schmoller, of Berlin University, on "The Borderland Between Technical Progress and Practical Economics," was of general interest. He traced the history and development of technical skill as applied to the implements and machinery of civilized life up to the date, about a century ago, when the exact sciences began to furnish the general basis of technical progress. He called attention to the development of social and political life as synchronous with the modern progress of mechanics as applied for industrial purposes. The age of machinery was the age which had witnessed the recognition of the political and legal equality of all the citizens of the State. In the year 1750, when Germany had a population of 18,000,000, of whom 9,000,000 were laborers, the proportion of the physical power exerted by the human factor in economic activity was to the power exerted by machinery in the ratio of one to one. In the year 1895, when Germany had a population of 56,000,000, of whom 28,000,000 belonged to the laboring classes, the proportion of manual labor to labor done by machinery was one to six, or, according to other estimates, as one to ten. Nevertheless, it was recognized that the machine without the superintendence of the human factor was merely an automaton, and that its productivity could only be immeasurably increased in cases where industrial processes could be resolved into a variety of constantly recurring and identical movements.

LETTERS TO THE EDITORS.

The Metric System.

To the Editors of Electrical World and Engineer:

Sirs.—The criticisms of Mr. G. W. Colles, in your issue of July 18, on the metric system, are at least interesting reading, but a betrayal of less animus on the part of the writer would have given greater force to his remarks. As to the German writer quoted, his attitude is not unreasonable in a conservative German appealing to the prejudices of the older generation. It is, however, significant that the younger German generation had enough common sense to adopt the metric system, the newness of which proves it to be the product of an advanced civilization.

The most conservative of the civilized nations is without question Germany; and if at any time during the last thirty years there had risen any cause whatever to serve as an excuse for going back to the old "jumble of weights and measures," many attempts in the Reichstag would surely have been made to repeal the law compelling the use of the metric system. Everybody there admits the superiority of this system, and more than once was the writer there pitied because his fellow countrymen are so far out of touch with the modern spirit in this respect. It is, however, true that in smaller towns and villages I found some good old souls who still tenaciously clung to the discarded system, so far as the law would allow.

If Congress introduces the metric system in all the governmental departments, it would not be long before the public would not only be reconciled to the system, but clamor for it. The public ought to be credited with having at least that much common sense.

It is rather hard-hearted on the part of Mr. Colles to offer our government as "a dog to try nostrums on": but it would be still more hard-hearted to withhold a remedy for our present commercial disability in the foreign trade arising from the use of a system of exchange even more absurd than that of the Chinese or Hottentots.

SANTA ROSA, CAL. J. G. VOGEL.

Absorption of Hertzian Waves.

To the Editors of Electrical World and Engineer:

Sirs:—I have just read with much interest in your issue of June 20 the article on "Recent Progress in Wireless Telegraphy," and particularly that section referring to Fig. 3, page 1053. In order to propagate electrical waves in a definite direction, Mr. De Forest surrounds the antennæ with a metallic screen connected to earth. I beg to refer to some experiments which I made in the same direction as early as 1899, partly in collaboration with Lieut. Poncelet. The method which I employed is analogous to that of Mr. De Forest, and my results corroborate the results which he obtained. An account of the experiments was published in *Comtes Rendus* of September, 1900, and I quote below an abstract of this paper which appeared in the *London Electrician*, October, 1900 (No. 5, p. 879):

"Signor Emile Guarini and Lieut. Poucelet have sent us a joint communication on experiments they have made with screens placed between a Wimshurst machine and a coherer. The Wimshurst machine, provided with its usual condensers, emitted Hertz waves which affected the coherer, and the experimenters satisfied themselves that.

only direct waves need be taken account of, as when a screen was placed between the coherer and the machine the former was protected. The distance between coherer and machine was a few metres. It was found that the human body, interposed between the machine and the coherer, effectively absorbed the rays whether the body was insulated or not. This might have been expected. On the other hand, a thin sheet of iron, which would not screen the coherer under normal conditions, screened it, when connected with the earth. The writers try to explain the different action of the insulated and earthed iron plate by the hypothesis that this metal screen 'constitutes a new radiator acting by induction from the transmitter.

"'The electric waves,' they continue, 'do not pass a metallic screen, but produce in it induced oscillating currents, which in their turn produce a radiation in space.' Earthing the screen prevents this inductive effect, they suggest. We think that the authors should have examined carefully their experimental conditions, and have endeavored also to reproduce the effect with a different arrangement of apparatus, before putting forward this theory. It is a pity that so much energy is wasted in methodless experiment in a field in which patient and methodical investigation is urgently needed."

The experiments above referred to were continued until several months ago, with some modifications introduced. The later results will form the subject of an article now under preparation.

BRUSSELS, BELGIUM. EMILE GUARINI.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

The Vector Diagram of the Compensated Motor.—HEYLAND.—An article, illustrated by diagrams, in which the author discusses in detail the construction of the vector diagram for a compensated motor, similar to that drawn by him for an ordinary induction motor years ago, and noticed in the Digest at the time. The diagram gives an interesting insight into the mechanism of the compensating action. If the compensation is zero, the ordinary induction motor diagram is obtained. As the compensation becomes higher, the diameter of the diagram circle increases, thus indicating the greater efficiency of the motor. It is also shown by the diagram that the efficiency can be increased by shifting the brushes. The losses in the compensated motor are smaller than in the ordinary induction motor. The stator field is the same as in the latter, the rotor field is increased, according to the compensation, but the iron losses in the rotor can be neglected. The copper losses in the stator become smaller for a given output, as the current decreases with decreasing phase difference. The copper losses in the rotor from a given load upwards also become smaller in the rotor than they are in the ordinary rotor. The diagrams also show that for a certain output the slip is always less than in the ordinary induction motor, and in the same proportion, as the rotor field becomes greater on account of the compensation. A shifting of the brushes gives the result that the slip, when the motor is running without load, is not exactly equal to zero, but may even eventually become negative. The characteristic difference between the diagram for the ordinary induction and the compensated motor, is that the former has only one diagram, while a number of them are possible for the latter, according to the changes in the position of the brushes and the strength of the compensation.—*Elek. Zeit.*, July 23.

High-Tension Transformers.—FARLEY.—A paper read before the Canadian Electrical Association, dealing mainly with the transformers on the Shawinigan Falls line, as typical of the latest and best practice in the design of high-tension apparatus. The rising transformers are designed to step up from the generator pressure 2,200 volts two-phase, to 50,000 volts three-phase. The lowering transformers step down from 44,000 volts three-phase, allowance being made for a line drop of 12 per cent., to 2,400 volts three-phase, two transformers being connected in "T." Taps for 86.7 per cent. are provided in both the high-tension and in the low-tension winding; since two transformers connected in this way have a slightly higher efficiency and a better regulation than they would if connected either in V or in T, with the full windings of the transformers in use. The transformers were to be designed for operation at either 30 or 60 cycles. A design was made for a 30-cycle transformer of 1,110 kw for the raising and 1,000 kw for the lowering, the characteristics being such that high efficiency and good regulation would be obtained. Both high-tension and low-tension windings were made in two equal parts, with terminals connected either for series or multiple connections. For 30 cycles the windings were to be connected in series, and for 60 cycles in multiple; the capacity of the transformers is, therefore, doubled in the latter case. Operating at 60 cycles, the transformers will then deliver their rated output with an ohmic drop only one-half of that for full load at 30 cycles, but the inductive drop will be the same under either condition, and the regulation, therefore, at 60 cycles is better than at 30 cycles, the exact figure in the case of the raising transformer being for loads having a power factor of 100 per cent., the extremely low value of 0.376 per cent. With the number of cycles increased by 100 per cent. and the number of effective turns decreased by the same amount, the flux density in the magnetic circuit will be the same, the loss per cycle being slightly more at the higher frequency than at the lower. The iron loss is, therefore, a little more than double at 60 cycles. The transformers are of the oil-insulated type, and the heat is removed from the oil by means of the conventional cooling coils through which water is circulated. These coils are of brass tubing and have no connections or joints of any kind inside the case, so that the danger from leaks is reduced to a minimum. The coils are wound in sections of only one turn per layer. The terminal board for the high-tension leads presented a more difficult problem; its solution was found, however, in the use of standard porcelain insulators mounted on pins and cross arms. Since the insulators are under oil, a compact arrangement was effected which has the merit of making this one of the strongest points of the transformer. A novel feature was introduced into the design of these transformers which lessens to a great extent the risk to surrounding property from the presence of the quantity of oil in which the transformers are immersed. The scheme involves the safe and rapid transfer of the oil to a place of safety in case of fire in the transformer building. At the bottom of the transformer tank there is placed a large valve, which connects directly with the water mains. In case of a fire this emergency valve may be opened and the oil forced out at the top of the transformer into a sink hole. The substantial construction of the transformer case, however, together with the water which will then fill it, will protect the transformer itself from harm, the only damage likely to occur being the wetting of the apparatus.—*Canadian Elec. News*, July.

REFERENCE.

Care and Management of Electric Generators.—CREED.—An illustrated article giving some points on the proper cleaning of commutators, fitting of brushes, etc. The article is intended for the dynamo tender.—*Power*, August.

LIGHTS AND LIGHTING.

Radiation from the Nernst Lamp Glower.—HARTMAN.—A long article, illustrated by numerous diagrams and tables, in which the author gives the results of spectrophotometric investigation of the luminous radiation from the Nernst lamp glower under varying current densities. The apparatus used was a Kirchhoff spectrometer, having a callimeter with two unilateral micrometer slits, which was adapted for the purpose of the investigation. The arrangement and standardization are described in detail. As a standard source of light an acetylene flame burning under constant pressure was used. The Nernst lamp used was a 104 volts alternating-current lamp. The diaphragmed acetylene flame used as a standard was determined in terms of the Hefner standard. Currents from

0.2 amp to 1.5 amp were used. The author arrives at the following conclusions. It appears that at the rated normal current strength the radiation from the glower of the Nernst lamp is relatively rich in the more luminous waves of the spectrum. It exhibits no marked selective radiation. Its light intensity apparently increases with age and is relatively less rich in the short, but richer in the long waves, than that from the acetylene flame, but its radiation rapidly becomes more like that from burning acetylene with increasing current strength. At current strengths below the rated normal value, the increase in intensity with increasing current strength is most marked in the long waves, and above this rated normal value of current strength the increase in intensity is most rapid in the short waves. At current strengths below the rated normal value the Nernst lamp is relatively less rich in short waves than the flame of the Hefner lamp, while above this current strength the opposite is true. At rated normal current strengths, or slightly above this, the color of the Nernst lamp radiation is very similar to that of the Hefner lamp. The luminous radiation from the Nernst lamp corresponds very closely to that from incandescent calcium.—*Phys. Rev.*, August.

Possibilities of Future Economics in Electrical Illumination.—Chamen.—A paper read before the recent meeting of the Municipal Electrical Association of England. The author thinks that the outlook in the direction of working the ordinary incandescent lamp at a materially higher efficiency than at present, is not very encouraging. He then passes over to the Nernst lamp and the cost of energy required by it. He states that a large number of these lamps have been in use in Buckingham Palace for the past 13 months and have reduced the consumption of current by about 50 per cent. He thinks that there is no apparent reason why some combination of a carbon filament with one or the other of the substances which give off a brilliant light, when heated to a moderate extent, as in the Welsbach mantle and the Nernst lamp, could not be evolved. These lamps would combine the advantage of instantaneous lighting with that of high efficiency. The author then considers the Hewitt lamp and states that it seems to have a great future before it. The absence of red rays in this lamp is an objection which he feels sure will be overcome. Arc lamps, having carbons made of a mixture of carbon with other materials, are next taken up. The difficulties which this arrangement encounters are enumerated. The author feels sure, however, that these difficulties will be overcome.—Lond. *Elec. Eng.*, July 17.

Power.

Variable-Speed Motors and Their Relation to New Shop Methods.—Lozier.—A paper read before the recent meeting of the Canadian Electrical Association. The author first discusses the new shop methods of working every tool in the shop at its highest output, and making it possible thereby to increase the output of the average shop working under the old conditions by 300 to 400 per cent. He says that in most cases a standard shunt-wound, direct-current motor of about 600 revolutions at 250 volts is the thing for all classes of work. Its principal features should be: (*a*) its armature coils should be of a type designed to carry heavy overloads without deterioration of insulation; (*b*) its design should provide for low armature reaction to permit of high speeds with weak fields without sparking; (*c*) its structure should be of the protected type, but the enclosed motor should be avoided except for special cases; (*d*) it should be in a condensed and handy form, so as to be conveniently applied to any class of tool; (*e*) it should be interchangeable, so that it can be applied to any tool without being specially designed for that purpose. In this manner a stock of motors can be drawn upon for such necessities as may arise, and of such capacity as the particular tool in question may demand, one motor being readily exchanged for another should circumstances require. The speed range, in the author's opinion, is the backbone of the whole system, and should be selected with a view to meet the maximum requirements of any operation in the particular shop. Any of the mechanical methods of speed variation has the advantage that in reducing the speed of the tool, the size of the motor may remain the same, if the same amount of work is to be done by the cutting tool. This does not hold true if the motor speed is varied within itself electrically. The electrical method has the advantage that it can vary the speed of the motor as it runs, at will, and while the work is being done. This is an advantage that the mechanical method does not as yet possess to anything like the same degree. It therefore, in the opinion of the author, appears best to combine the two methods, wherever the requirements of the case demand a large range of speed. The practice now is to use a mechanical arrangement in connection with a variable-speed motor, the former consisting of a single or double-reduction back gear, which enables the motor to reach the lower speeds of the range which are thrown out, and the motor will run directly on the spindle in the higher speed range. Of the two methods of varying the speed of motors, the author states that the multivoltage system covers the amount of current that must be handled at the lowest voltage, while the field weakening determines the high limit, when it reaches the sparking point of the motor, or perhaps the armature's peripheral speed. In common practice the speed ratio in the motor itself of 7½ to 1, is found to fit the majority of cases. In this arrangement the lowest voltage is 90 and the highest 250, the field of the motor being weakened so as to increase its speed by 150 per cent.—*Canadian Elec. News*, July.

Heavy-Service Lathe with Electric Drive.—A short, illustrated article. The machine is specially designed for electric motor drive, without reference to the forms developed for belt-driven machines. The usual cone-pulleys in the headstock are replaced by a seat for the driving motor and its gearing and the electrical control switches. The machine is designed for the heaviest service which two tool posts can require. The two tool posts can be fed simultaneously outward or inward. The machine comprises also a two-speed gear change in the transmission from motor shaft to spindle, a hand traveling attachment for the tail stock and a lubricator pump belted from the motor shaft. The driving motor is a shunt-wound machine rated at 20 hp. The motor is supplied by a four-wire system, which makes six different voltages available. Since each voltage has a definite motor speed corresponding to it, there are six speeds possible without employing resistances; a field rheostat for weakening the field circuit serves to give the intermediate speeds. A two-speed pinion gearing again doubles this range of speeds. The changing of connections is all done automatically by a controller mounted at the front of the head-stock below the lead screw.—*Eng'g News*, July 30.

REFERENCE.

Electric Pillar Cranes for Handling Cupola Charges.—An illustrated note, describing a recent construction of electric cranes to be used in the foundry. The effective radius of the jib is 16 ft. and the hoisting capacity is 4 tons. The operator controls all the motions from a small cabin, which swings with the crane. There are three direct-current, 220-volt motors for swinging the crane, racking the trolley in and out, and hoisting the load. The speeds are 20 to 50 ft. per minute for hoisting, 100 to 150 ft. per minute for racking the trolley, and 3 to 5 r.p.m. for swinging.—*Eng'g News*, July 30.

Traction.

The First Third-Rail Road in Switzerland.—An article describing a line, recently put in operation between Fribourg and Morat, 22.4 km in length. Part of the line was previously operated by steam, and electricity was adopted on account of the grades, which are from 2 to 3 per cent. After careful consideration direct-current motors were adopted in preference to three-phase, because storage batteries could be used at the station to equalize th load and act as reserve. Direct-current motors reduce their speed slightly on grades, but three-phase motors, which run at constant speed, would have to be designed of sufficient capacity to maintain this speed on the steepest grades, and this would require much larger motors than if direct-current was used. A third-rail contact was considered more desirable for large currents; the three-phase system reduces complications in the overhead work. The overhead system is used at certain stations, elsewhere the third rail is employed, which weighs 25 kg per meter and is laid in 20-meter lengths; the insulators are spaced 4 meters apart. The top of the third rail is 135 mm above the top of the track rail and 660 mm from the gauge line, and as it is held in the insulators by gravity only, it is anchored at points by two insulated steel wires attached to the cross ties. The average train consists of one four-axle motor car, one three-axle trail car and three two-axle trail cars; it weighs 70 tons, has a speed of 23 km per hour on a 3 per cent. grade and 35 km per hour on a level. The motor car has two 150-hp motors, which operate at 750 volts. There are two sub-stations, each containing a storage battery consisting of

400 cells with a capacity of 207 amp.-hours, and also one synchronizing motor direct-connected to a direct-current generator of 100 kw. —*St. R'y Jour.*, July 25.

Track Construction with Special Reference to Rail Joints.—DAVIES. —The author states that the percentage of carbon in the rails in the best practice in traction is from 0.35 per cent. for a 50-pound rail to 0.55 per cent. for a 56-pound rail; rails of intermediate weight should have a corresponding percentage. The average percentage of phosphorus is about 0.06 per cent. and should not go above 0.1 per cent. Sulphur is very undesisable and should be kept as low as possible. Silicon should not exceed 0.2 per cent. The author then discusses the rail jointing and describes the process of making the Falk cast-welded joint. Bonding of the rails is then discussed in detail and the requisites for a good bond laid down.—Lond. *Elec. Eng.*, July 10; reprinted in *St. R'y Jour.*, August 1.

Traction Motor Suspension.—A note on some practical points. The suspension of a motor at three points, as is usually done on account of the reaction between the pinion and gear, tends to shift the motor out of horizontal alignment and so produce an uneven wear on the gear teeth. Instead of that the motor is mounted practically rigidly by a support at the pinion end of the motor.—*St. R'y Jour.*, July 25.

Ventilating Railway Motors.—A record of tests made on the Camden & Suburban Railway Company's lines, which indicate the practicability of ventilating and cleaning railway motors while in operation in regular commercial service. Natural draft is used, air being led by means of piping to the motor cases, and thence to an exhaust located on the car truck. Some data are presented showing the heat developed in motor cases in ordinary service and the reduction effected by the use of this apparatus.—*St. R'y Jour.*, July 25.

Car Acceleration Test.—An article giving an account of an acceleration test made on a car equipped with a multiple unit control. The car weighed 30 tons. An analysis of the diagram shows that the maximum consumption was 9 kw per ton and 8.55 kw-hours per car-mile, or 272 watt-hours per ton-mile.—*St. R'y Jour.*, July 25.

A Rational Train Resistance Formula.—BLOOD.—A reply of the writer to the criticism of his train resistance formula published in the June 27 issue. He first states that he is justified in grouping the head and stern air resistance in one expression, and also justifies his making this factor independent of the length of the train. He also gives the arguments in favor of the use of the fractional exponent. He then takes up the terms A and B, and states that he was justified in his use of these as given in his formula, because by his hypothesis A associates all forms of resistance which are independent of the speed, and of these the journal resistance is the largest portion. Also that B associates all terms which are a lineal function of the speed, and of these the track resistance is the most important. He thinks that empirical formulæ will lead to error, as they do not take into account new or extraordinary conditions, whereas the rational formula can be made to suit actual conditions if the coefficients are properly selected. In the same number there is an editorial on this matter, in answer to the above letter. The formula is still considered an impractical one, because sufficient information has not yet been obtained as to the factors of train resistance to calculate a rational formula. This is true of all the coefficients. His final term, which uses a fractional exponent, is also disapproved when used in combination with the first power of the same variable and not so desirable as either a formula with integral coefficients, or a formula of the $a - bx^n$ type, as it has no recognized mathematical precedent. It is also more difficult to compute than an expression with integral exponents. In conclusion, Blood's investigation of the subject is commended, but the editor concludes that further information on train resistance is necessary before rational formulæ can be constructed.—*St. R'y Jour.*, July 18.

REFERENCES.

Electric Interurban Traction Line.—An article describing the Columbus, Buckeye, Lake & Newark Traction Company's line, which has just been extended to Zanesville. This system is expected to play an important part in the operation of through trains between Cincinnati, Cleveland, Pittsburg and Toledo. A description of a modern power plant and distribution system is included, as also descriptions of the equipment of the road, including passenger, freight and express cars and a number of combination coaches.—*St. R'y Jour.*, August 1.

Boosters.—STEPHENS.—An article illustrated by a number of diagrams, showing the connection of boosters when used in combination with accumulators, especially for traction purposes.—Lond. *Elec. Eng.*, July 3.

Street Railway Power House.—A long, well-illustrated article describing additions to the generating equipment and the new car house of the Hartford Street Railway Company. A new unit installed consists of a 1,500-hp cross-compound engine, coupled to a 1,000-kw generator.—*St. R'y Rev.*, July 20.

Power Station of the Olean (N. Y.) Street Railway.—An illustrated description, especially of the newly-built station at Ceres, where natural gas is used as fuel under the boilers.—*St. R'y Rev.*, July 20.

Electric Cars in Cripple Creek.—A description of a line operating under steam railroad conditions. Steam trains run over part of the route. There are two lines, the grades on one being 10 per cent. Each car is equipped with four 52½-hp motors. The cars are dispatched by telephone.—*St. R'y Jour.*, July 25.

Notes on Railway Shop Practice.—A communication from an engineer, giving the results of an inspection of several electric railway shops and power stations in New England. A wide diversity of conditions and practice is revealed.—*St. R'y Jour.*, July 25.

Milford Street Railway System.—A description of the electric railway lines centering in Milford, Mass. Some engineering features are discussed, particularly the utilization of storage batteries for keeping up the line voltage. Direct current is employed and two of the lines have battery auxiliaries. On another line 10,000-volt alternating-current transmission, fed by an inverted rotary, is employed. A comparison is made of the results obtained.—*St. R'y Jour.*, July 25.

Emergency Car for Traction Roads.—A description of an emergency car in use at Orange.—*St. R'y Jour.*, July 4.

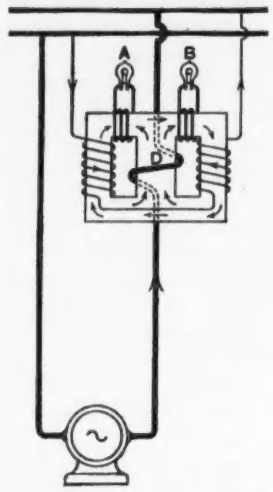
INSTALLATIONS, SYSTEMS AND APPLIANCES.

Single-Phase Motors as a Means of Increasing Station Earnings. —LAYMAN.—A paper read before the recent meeting of the Canadian Electrical Association. The author states that economical operation of central stations is inevitably drifting towards the ideal basis of generation of one form of current, and the development by every means possible of a high load factor. Operating engineers are specifying the installation of consuming devices, which afford the lowest first cost, and the simplest possible system of distribution. The author contends that the single-phase, alternating-current motor lends itself readily to the development of this general scheme of economic production. The author is an advocate of the following arrangement of station service: (*a*) For large plants—Polyphase generators, with switchboard arranged for operating; first, polyphase feeders for all large power and rotary converter service; second, single-phase feeders for all general lighting service, and for all small power work, the switchboard facilities being such that any single-phase feeder may be switched to either phase of the generator busses; third, independent feeder regulators for all polyphase as well as all single-phase feeders. (*b*) For small stations—Either polyphase generators with single-phase feeders, which may be thrown by the proper switchboard devices to either phase of the generator, and each feeder provided with independent pressure regulator; or, single-phase generators with single-phase feeders, each feeder being operated with independent pressure regulator. This policy with respect to station and distribution equipment is based on the conviction that the single-phase motor has come to stay, and that it affords an alternating-current central station—polyphase or single-phase—the ideal means of distributing small power. The author believes that single-phase motors should receive the preference of the operating engineer of multiphase stations, up to units of at least 15-hp capacity, and in selected instances up to units of even 35-hp capacity. The justification for the use of single-phase motors by polyphase plants arises from the lower first cost of individual power installations, and also the higher efficiency of these installations in small units. In conclusion the author gives a description of a single-phase motor.—*Canadian Elec. News*, July.

WIRES, WIRING AND CONDUITS.

Arrangement and Control of Long-Distance Transmission Lines. —COWAN AND ANDREWS.—The conclusion and discussion of their paper, previously noted in the Digest. The authors discuss methods of charging the cells and describe and illustrate in detail a method

which one of them worked out some years ago. They conclude with the description of a modification of the discriminating transformer, which may be used with alternating-current generators connected in parallel, for the purpose of indicating whether a generator is feeding the bus-bars or receiving current therefrom. Without some device of this character, the attendant has nothing to indicate, in the event of a failure, which generator to switch out, as the fault will cause the ammeters on both the defective and the other machines to indicate an excess current. The discriminating transformer is connected as shown in the adjoining figure. Red and green lamps, *A* and *B*, are connected respectively across the terminals of two secondary windings. A primary winding is connected directly across the bus-bars or across any secondary circuit excited from the main bus-bars. The effect of this primary winding is to induce a magnetic flux in the core of the transformer indicated by the thin arrows. A second primary winding, *D*, consists of one or two turns inserted in series with the generator connections. The



DISCRIMINATING TRANSFORMER.

effect of a generating current in this winding is to induce a flux in the direction shown by the thick arrows. The fluxes due to the two primaries oppose each other through the secondary connected to the red lamp, and assist each other to light the green lamp. Should the generator fail the direction of the series flux relatively to the shunt flux will be reversed, and as a consequence the green lamp will be extinguished and the red lamp lighted. The authors state that this current direction indicator has also proved of great assistance in disconnecting machines which were in parallel.—Lond. *Elec.*, July 17.

Electro-Physics and Magnetism.

Rôle of the Earth in Wireless Telegraphy.—Koepsel.—An article in which the author investigates mathematically the question whether the earth plays an essential rôle in wireless telegraphy. He thinks that it would be possible to get nearer to a solution of this problem if it could be proved that the influences which it is possible to exert on the earth with an ordinary sender are of such magnitude that they can influence materially the potential of the earth. He states that this appears at first sight paradoxical, as the electrostatic capacity of the earth is supposed to be infinitely great, but as a fact the earth has not such a great electrostatic capacity, it being only about 708 microfarads. He then investigates the question whether it is possible, with the relatively small means of modern wireless telegraphy, to disturb the potential of a globe of this capacity to a sensible degree or perhaps even to throw the globe into oscillations. He considers the case of an oscillating circuit with resonance wires on both sides. The resonance depends only on the product of the capacity and the self-induction of each resonance wire. Therefore, one of these values can be changed as desired. If, for example, a piece is cut off from one of the resonance wires, its self-induction and its capacity are, therefore, changed, and the resonance is disturbed. The piece cut off can, however, be replaced by a globe of a certain capacity, and this process can be repeated *ad libitum*. It is found in this way that the greater the wave length, the greater will be the radius of the globe which replaces an aliquot part of the wire. For instance, in order to replace with a wave length of 40 meters, 90 per cent. of the length of the resonance wire, there is required a globe of 6.57 meters radius. With a wave length of 4,000 meters it takes a globe of 407 meters radius to do the same thing. Furthermore, it is seen that with a wave length of 4,000 meters a resonance length of 10 cm from a wire 1 mm thick, would demand the connection of a globe of 979,000 meters radius. The capacity of such a globe is 9.79×10 to the seventh power, that of the earth being 6.37×10 to the eighth power; its capacity is, therefore, close to the capacity of the earth. When thick wires are used, the radii of the globes become still greater, and under these circumstances the capacity of the earth will be reached. The author then investigates at which wave length the earth will be in resonance with the oscillating system, if a certain minimum self-induction, which can be reached within practical means, is admitted for that piece of conductor which serves as the connection with the earth. He finds that with an oscillating circuit of a wave length of 10,000 meters, at one side of which a resonance wire of 2,500 meters length is carried vertically upwards and the other side of which is earthed through a wire of 100 cm self-induction, the earth can be gotten into resonance. He calculates that the amount of electricity necessary for this is 0.0009 coulomb, an amount which can be reached in practice without any difficulty. The maximum current rush would not go above 15 amp., with minimum damping. The author thinks that though Marconi, with his installations for ocean telegraphy, probably has not gotten the earth into complete resonance yet, as the wave length which has been used by him is still too short for this purpose, he comes very close to the numbers mentioned above. If it is borne in mind that the resonance phenomena do not manifest themselves suddenly, but show frequently very flat maxima, it is not improbable that he might have put the earth if not into complete, yet into quite appreciable resonance, so that fluctuations of potential of the magnitude of one volt do not appear to be excluded, and in this manner the ocean telegraphy would really have been earth telegraphy. The author explains the fact that horizontal wires are not nearly so effective as vertical ones, for the reason that the horizontal wires localize the action because they are near to the earth. The differences of potential will be considerable in the neighborhood of the sender, but will not extend to appreciable distances. The vertical wire, however, because it is vertical, has no appreciable reaction on the earth, and it will be able to exert such a reaction less and less with its increasing distance from the earth, and therefore the fluctuations of potential have to distribute themselves over the earth. According to this theory, it should be possible to get signs at any desired distance, if only the sender is constructed in such a way, that by its help the earth can really be put into resonance. The author states that the only assumption made in these considerations is that the phenomena which are observed with systems of small wave length, can be transferred to those of large wave length. Whether the law no longer applies with increasing dimensions can be demonstrated only by experiments on a large scale. But as changes in the resonance length up to 90 per cent. with wave lengths of 40 meters, do not begin to show any appreciable deviation from the resonance law, the author thought himself authorized to draw the last consequences from this law, which may throw an entirely new light on the phenomena of wireless telegraphy.—*Dingler's Polyt. Jour.*, June 20.

Electro-Chemistry and Batteries.

Electrolytic Manufacture of Vanadium and its Compounds.—Gin.—A paper read before the recent International Congress of Chemistry at Berlin. The principle of the process is based on the great conductivity of vanadium trioxide and on the facility with which vanadium trifluoride is formed when fluorine attacks the trioxide in the presence of carbon. The vanadium trioxide, prepared by calcination of vanadic acid in the presence of carbon, is mixed with a suitable portion of retort carbon and pulverized resin, and worked up under heat to a plastic paste. This paste is pulverized and is then wire drawn hydraulically into prismatic or cylindrical bodies, which are exposed to a high temperature in a hermetically closed oven. The electrodes thus obtained are protected from the heat and dampness until they are used. The electrodes are said to be able to stand a current density equal to 0.7 of that of carbon electrodes of the same section. The anode of the furnace consists of a bundle of these electrodes; the cathode consists of a block of iron. Vanadium fluoride is electrolyzed with the formation of vanadium at the cathode and fluorine at the anode, which forms there a new quantity

of vanadium fluoride, which is again electrolyzed. A good efficiency and sufficiently fluid bath is said to be obtained with a mean density of 2 amp. per sq. cm of the anode section and 6 amp. per sq. cm of the cathode, the voltage of the system being 11 to 12 volts. Some fluoride of iron is preferably added to the bath from time to time. Iron-vanadium alloys are thus obtained, and if iron is not introduced into the bath, almost pure vanadium may be obtained, but the tapping is said to be most sluggish and the contents of the bath ought in this case to be removed in the solid state, instead of by casting. It is stated that the process may probably be applied under identical conditions for the commercial manufacture of alloys of vanadium with copper, aluminum, manganese, etc., by replacing the cathodic bath of iron by a bath containing the metals whose alloy is desired.—Lond. *Elec.*, July 17.

REFERENCES.

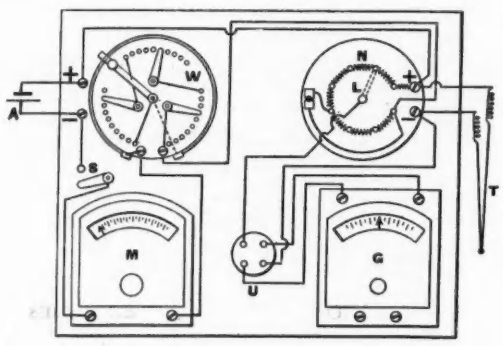
Accumulators in Dish Form.—HERZOG.—An illustrated description of a new type of accumulator and the process of manufacturing. The accumulator plates are dish-shaped and are piled one on top of the other, the insulation of the various plates being accomplished by means of glass balls. The inner side of each plate acts as the positive electrode, and the outer side as the negative. The plates are provided on both sides with channels serving for the reception of the active mass. A table is given of the capacities in ampere-hours, etc., of the various types.—*Schweiz. Bl. f. Elek.*, June 22.

Electric Steel Furnace.—An illustrated description of the Kjellin electric steel furnace in operation at Gysinge, Sweden. The arrangement may be considered as an alternating-current transformer, the primary of which is supplied with 3,000 volts alternating current. The secondary is a single turn and consists of the material to be fused; there are, therefore, no electrodes.—*Electrochem. Ind.*, July.

Classification of Electrochemistry.—TOWNSEND.—A continuation of his article in the first part of which he gave an outline of a systematic classification of the art of electrochemistry. He now discusses the characteristic features of each class separately.—*Electrochem. Ind.*, July.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A New Potentiometer.—A short illustrated description of an instrument designed by Prof. Lindeck and made by the German Physikalische Reichsanstalt at Berlin. A diagram of connections of the instrument is shown in the adjoining figure. *A* signifies the accumulator, *W* a variable resistance, *M* a milliammeter. The current also flows through a permanent resistance. Connected in shunt to the latter is the e.m.f. to be measured, in series with a galvanometer, *G*. To determine the e.m.f. in question, the variable resistance is adjusted until galvanometer is at zero; then obviously the desired e.m.f. is found by multiplying the current by the fixed resistance. Several fixed resistances are provided for measuring different e.m.f's. The e.m.f. to be measured is connected at *T*. The resistance box, *N*, contains three resistances, to be used for checking the milliamperemeter. If this is to be done, *T* is replaced by a standard cell and the compensation is carried out as usual. There are three resistances in *W*, consisting of three parts, containing 9 x 100, 9 x 10, and 9 x 1 ohms. With certain combinations of resistances the ammeter, if correct, will point to 150, 100 and 50 respectively on the scale. The resistance, *W*, has also a wire of about 1.5 ohm resistance arranged around the periphery of the plate forming the cover. It seems that the chief idea is to use an accurate milliammeter, together with a known resistance in order to measure voltages.—Lond. *Elec.*, July 10.



NEW POTENTIOMETER.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electrical Operation of Switches and Signals.—A long, well-illustrated article describing the Crewe system. The system depends on the use of long-pull electromagnets. A high resistance shunt is automatically switched into series with the signal magnet, as soon as the arm is lowered and the signal is held off in this way with quite a moderate expense of current. The long pull electromagnets have hollow conical pole pieces, and the end of the armature is also turned conical to fit into this. By adopting a very narrow angle, it will be seen that for a given travel of the armature the distance across the air-gap may be made as small as desired, and at the same time, since the lines of force start out from the whole inner circumference of the hollow, conical pole pieces, the area of the gap is much larger than it would be if the pole and its armature were cut off square in the usual way. Both these facts tend to diminish the magnetic resistance of the air-gap and thus the amount of current needed to move the armature. In the area of points (or switches, as they are called in this country), direct-pull magnets are not used, but a small reversing motor is employed instead. This motor is placed in a cast-iron box sunk below the rail level, near the points to be operated. The armature is arranged so that it can be replaced by a new one in a few minutes. The armature shaft drives by means of clutches a worm shaft, through which a wheel, having cam grooves on it, is rotated. These cam grooves act on the point rods and locking bars, the arrangement being such that to throw the points the signal man has merely to move over one lever in his cabin. The movement of the lever locks the signals, giving admission to the road for which the points are to be moved, throws over the locking bar, unbolts the points and finally releases the signals for the road for which the points are now set. The construction of the various devices is illustrated and explained in detail. The interior of one of the signal cabins is also shown.—Lond. *Eng'g*, July 17.

REFERENCE.

Rôle of the Earth in Wireless Telegraphy.—KOEPSEL.—See abstract under Electro-Physics.

New Books.

EXPERIMENTS WITH VACUUM TUBES. By Sir David Salomons, Bart, M. A. London: Whittaker & Co. 49 pages, 54 illustrations. Price, 2 shillings.

This little book describes in a clear and entertaining manner a number of interesting facts pertaining to vacuum tubes. Many of the observations recorded in the book appear to be original and display considerable experimental skill. The writer has taken pains to express his observations and deductions in clear and simple language. The treatment of the subject is entirely practical. There are no mathematics, and if a theory is propounded the facts are brought forward upon which the theory is based. The book will be prized by all who are interested in the phenomena of the transmission of electric currents through gases.

DIE BERECHNUNG ELEKTRISCHER LEITUNGSNETZE. By Joseph Herzog and Clarence Feldmann. Second Edition. Vol. I. Berlin: Julius Springer. 402 pages, 269 illustrations. Price, 12 marks.

This book deals with the graphics and arithmetic of conducting networks. The subject is very fully treated, both with relation to direct and to alternating currents. The treatment is clear and well illustrated by examples. It would be well if a translation could be secured for English-reading electrical engineers. The first chapter deals with the elements of the subject. The second chapter considers the simplest conducting systems. The third discusses the theory of conducting networks. The fourth sets forth the distribution of current and pressure in conducting networks. The fifth takes into consideration the distribution of current and pressure over long conductors. The book deserves the study of all electrical engineering students.

THE WORK OF WALL STREET. By Sereno S. Pratt. New York: D. Appleton & Co. 286 pages, illustrated. Price, $1.25.

Mr. Pratt, who is well and favorably known as a skillful journalist, has given special attention for many years past to financial questions, and has not allowed his other duties, such as New York correspondent for the *Philadelphia Ledger*, to interfere with his continuous study of the problems that center around the southern tip of Manhattan Island. In fact, this extremely handy and interesting book could not have been written by any one who was not only an expert but had got his facts at first hand as a financial reporter and economic writer. Mr. Pratt has, indeed, evidently accumulated so much material, it would be a worthy ambition in him to elaborate it some leisure day in a more pretentious book.

Dealing with dry statistics and serious aspects of finance, Mr. Pratt has made his treatment broadly philosophical and human, so that every page is illumined by some reference or fact or anecdote that catches the eye and retains the attention. Such a chapter, for instance, as that on panics, is at once thrilling as a record of the ups and downs of fortune, but full of information as to the manner in which economic science and practical finance endeavor to lessen the evils of reckless speculation and consequent loss and anxiety.

There are many notes and references of interest in the book in regard to the employment of electrical communication, and it is difficult to conceive of the Stock Exchange and modern banking without the telegraph, the cable, the telephone and the ticker. Incidentally, we observe that Mr. Pratt says that telephones were introduced in 1876. This must be a slight anachronism, as it was in that year the crude apparatus was shown by Prof. Bell at the Centennial. But it is certain that Wall Street was quick to adopt the new appliance, and some of our readers will recall Mr. E. A. Calahan's recent articles on the evolution of such methods "in the street."

STEAM POWER PLANTS. Their Construction and Design. By Henry C. Meyer, Jr., M. E. New York: McGraw Publishing Company. 160 pages, 65 illustrations, 16 plates. Price, $2.00.

An admirable feature of this book is the essentially practical character of the information which it conveys. As a rule the writers of books on steam engineering appear to consider it necessary to preface the practical treatment of questions with a compilation of matter from text-books and theoretical treatises, there very often being little connection between such matter and the part original with the author. In the present book statement of theory, where it appears at all, is confined to but one or a few introductory paragraphs to a chapter, necessary for a logical development of the subject treated.

The first chapter is on the design of steam power plants, which is treated under the sub-heads of location of plant, drawings, type of power house, building foundations and engine foundations. The following two chapters are on steam boilers, complete specifications for tubular and water tube boilers being included. Chapter IV is on the selection of engines, and chapter V on specifications for the same. Steam and water piping are considered in chapter VI, condensers in chapter VII, and feed water heaters and economizers in chapter VIII. Chapter IX is on mechanical draft, chapter X on chimneys, and chapter XI on coal handling, water supply and purification. We know of no book on steam engineering that should prove more useful to the electrical engineer who from time to time has to deal with the design of the steam end of electrical plants, or who may be called upon to check steam equipment specifications.

THE POLYTECHNIC ENGINEER. Annual Organ of the Engineering Society of the Polytechnic Institute of Brooklyn, 1902-1903. 114 pages.

The preface of this volume opens with a criticism on similar books on the ground that the contributions are often by eminent experts and not representative of the efforts of society members; and it is added that the design is to limit the pages to papers prepared by members of the college engineering society. The papers are eleven in number, only one of which, however, treats of an electrical subject. The author of this is Mr. R. W. Hutchinson, Jr., the title being, "The Present Status of Industrial Electrochemistry." This gives an excellent résume of the more important commercial electrochemical processes, particularly those of recent date. In a paper entitled, "The Turbine, an Ideal Engine," Mr. Henry T. Leas sketches the theory of steam turbines, and describes in detail the Parsons and De Laval types. A paper by Mr. O. H. Clarke sums up the advantages and disadvantages of organic and mineral lubricating oils, the comparison being in favor of the latter.

ELECTRICAL INFLUENCE MACHINES. Their Historical Development and Modern Forms, with Instructions for Making Them. By John Gray, B. Sc. Second Edition. New York: D. Van Nostrand Company. 296 pages, 105 illustrations. Price, $2.00.

As the only work in the English language on static electrical generators, the new edition of this useful book is very welcome. Descriptions of the latest machines which have proved practically successful have been added, and some machines described in the first edition which have not given results of any practical value, have been omitted. A short account of the electronic theory is given and some additions is made to the early history of the static machine with oppositely rotating plates. As in the first edition, the greater part of the space is taken up with a description of the several types of Holtz and Wimshurst machines, about half of the contents being devoted to these. The author states that theoretically the static machine is equal in efficiency to the dynamo electric machine; owing, however, to leakage and faulty design, the practical efficiency of the former is only from 5 to 10 per cent. There is thus evidently much room for improvement, and the author points out in what direction this may well take place.

ELECTRICAL PRACTICE IN COLLIERIES. A Manual for Colliery Managers, Under-Managers, Engineers and Mining Students. By Daniel Burns. London: Charles Griffin & Co. 221 pages, 142 illustrations. Price, $2.00.

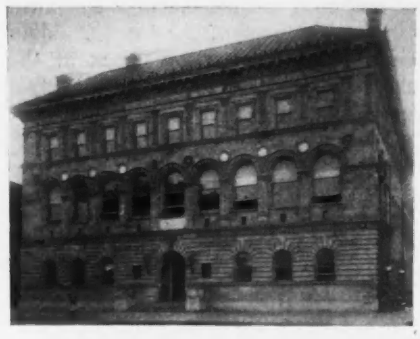
The use of electricity in mining of late years has been so extensive, it has created virtually a new department of electrical industry; and this little volume is a striking evidence of the specialization that has already set its mark on the new field. A good part of the matter in the volume would also be pertinent in any other treatise dealing with questions of light and power in general, but as the mining engineer is kept specially in mind by the author, there is no harm in telling him some of the things he ought to know, if the instruction is clearly and usefully given, as it is here.

The more direct treatment of electricity in mining may be said to begin with Chapter V, where lighting is taken up. The next chapter deals with pumping, and then comes haulage, while coal cutting occupies the whole of Chapter VIII, and a final chapter is given to miscellaneous appliances, in which again lamps crop up, although they should apparently fit into Chapter V. Good practice is indicated and approved in each instance and a lot of practical figuring is given, so that the engineer can determine what results he ought to get from the capacity of his apparatus. The chapter on haulage is a little disappointing, for it is made to include with that subject the kindred but by no means identical one of transportation; so that mining locomotives hardly get the space and detail to which we think they are entitled. On the other hand, coal cutting is dealt with broadly and fully, and we are interested to note that in commenting on the performance of an American coal cutter, it is said that it could not probably be repeated in Great Britain, chiefly because "British coals are on the whole harder and more difficult to cut than the average American coals." It is, however, admitted that a great deal depends upon the willingness and aptitude of the workman, and we have more than once heard English employers say that they could not get out of American tools the records made almost as a daily commonplace in this country. Under the head of miscellaneous appliances come drills, and we are glad to note that the author has a favorable opinion of them, though admitting the rareness of the percussion type.

CORRENTI ELECTRICHE ALTERNATE. Semplici, bifasi e trifasi. Manuali Hoepli. By Attilio Marro. Milan: Ulrico Hoepli. 615 pages, 217 illustrations. Price, 6.50 lires.

This is a practical treatise on alternating currents and alternating-current machinery, intended for the use of electrical engineers and students of electrical transmission and distribution plants. The book is in heavy pocketbook form and contains a great variety of practical information in readily accessible form. The illustrations are inferior from the standpoint of the American artist in illustration; but this is not a vital defect in a purely utilitarian volume. The work relates partcularly to Italian construction and is specially interesting as clearly setting forth European methods of installation.

Electrical Plant in the Newark Free Public Library.



NEWARK, N. J., LIBRARY.

The buildings of the Free Public Library of Newark, N. J., occupy about 102 x 220 ft. The main building is four stories in height and 102 x 137 ft. in area, and is constructed mainly of brick, but faced on the front and part of the sides with Indiana limestone appropriately carved with figures and names prominent in art, literature and bookmaking. The interior is more strikingly beautiful. The entrance vestibule is executed in white Italian marble and mosaic and the central rectangular corridor into which it leads has a wainscotting of marble and a plaster frieze and ceiling decorated in color. Through the center the corridor is open to the skylighted roof, leaving hallways at each floor in the torm of arcades surrounding the court-like center space. From floor to floor these are reached by two bronze-railed marble stairways at each side except from the first to the second floor, where they are replaced by a single broad staircase entirely of marble, rising through the middle of the corridor, with its space directly in front of the main entrance, and its head at the entrance of the library delivery room on the second floor.

The buildings are lighted by direct-current arc and incandescent lamps and heated with exhaust steam by indirect radiation in connection with a plenum system of ventilation, and supplementary direct and direct-indirect radiation in the most isolated locations. A passenger elevator, five book-lifts, a plenum fan and three exhaust fans, all motor-driven, constitute the power load. The mechanical plant, including boiler and engine rooms, occupies a third separate building, located at the other rear corner of the main building, on a level with and adjoining the basement through which the pipe, duct and wire runs are carried. The boiler room is 34 ft. x 24 ft. under the rear court yard, so that coal may be brought in from the street and dumped through chutes to the storage bins, which are at one side of the room facing the boilers with a 6-ft. firing floor between. The steam generating equipment comprises two 100-hp return tubular boilers set side by side with space left for a third. They were furnished by the Erie City Iron Works, are 5½ ft. in diameter x 16 ft. long, and contain 5½ x 6-ft. grates. The boiler settings are arranged with fire brick flues above so as to cause the gases of combustion to pass back over the shell after passing through the tubes before being finally discharged through the brick smoke header. The latter contains a damper automatically controlled by a Kieley regulator to maintain the desired steam pressure, and connects to a rectangular brick chimney 74½ ft. high and 3½ ft. square on the inside. From a dry pipe in each boiler, connection is made by a 6-in. copper bend to a 10-in. steam header, which pitching slightly downward, passes through the dividing wall into the adjoining engine room, where it terminates in a down-curving elbow, the bottom being closed with a blank flange and dripped to a steam trap. A 7-in. pipe is taken from the upper side of the main near the end to a point overhead between

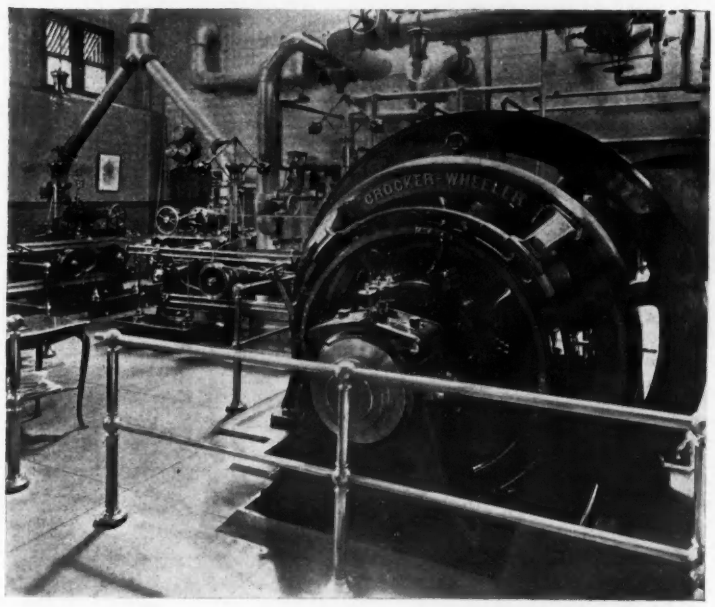


FIG. 2.—DYNAMO ROOM, NEWARK, N. J., PUBLIC LIBRARY.

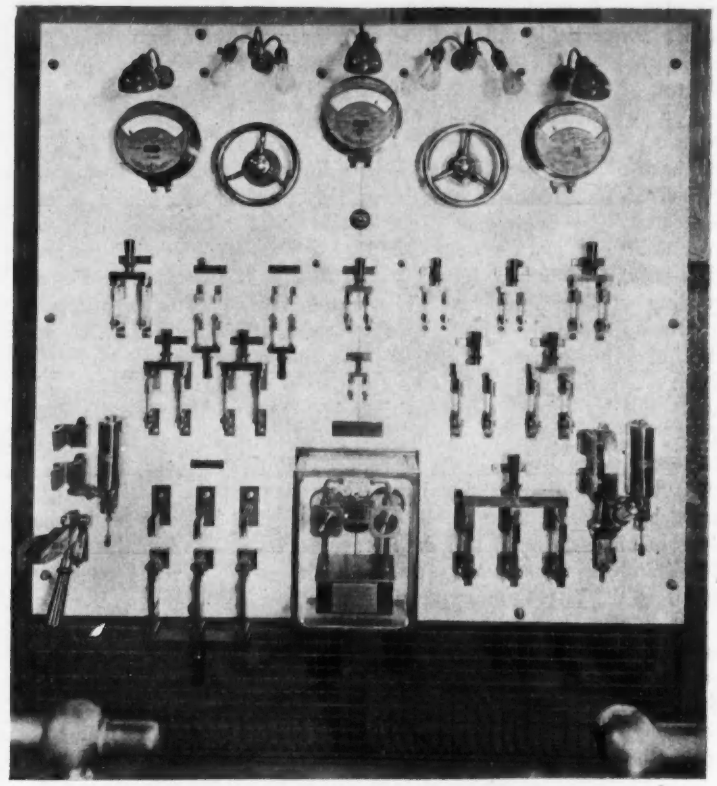


FIG. 3.—SWITCHBOARD, NEWARK PUBLIC LIBRARY.

the engines where through an inverted Y it divides into two 5-in. pipes to supply each of the two engines.

The engines are Watts-Campbell Corliss type 16 x 30-in., horizontal side-crank, extra-heavy engines, and drive two Crocker-Wheeler 100-kw direct-current, 8-pole generators by direct connection at 120 r.p.m. When admitting steam at an initial pressure of 85 pounds, cutting off at one-quarter stroke, and exhausting with a back pressure of 5 pounds per square inch, the engines are capable of developing 136 ihp. Speed regulation is obtained in the usual manner by altering the point of cut-off through the agency of a fly-ball governor and mechanism, but to avoid accident a second governor is provided and so set that an increase in speed of 10 r.p.m. will cause the closing of a butterfly valve, cutting off the steam supply. The fly-wheels are 10 ft. in diameter, weigh 20,000 pounds and are placed between the cranks and generators.

The generators were designed for a normal load of 800 amp. at 125 volts and a safe momentary overload of 40 per cent., but have proved capable of carrying even more, and for a considerable length of time. On one occasion, while only one set was running, the load was gradually increased until at 1,130 amp., or 41 per cent. overload, the engine reached its limit of power and refused to cut off. It is reported that throughout the test there was no noticeable sparking at the commutator and that at the close of it the field coils were only about 30°, and the brushes 7° warmer than the surrounding air. A total of some 2,500 16-cp lamps constitute the lighting load, and, as previously stated, the power load includes four motors in connection with the ventilation system, five motors for book-lifts and one motor for the passenger elevator.

The air circulation for ventilating is established by an 8-ft. Seymour disc fan driven by belt at 220 r.p.m. by a 15-hp motor, and discharging in that time between 63,000 and 65,000 cu. ft. of air. The removal of the vitiated air is made positive by the use of three exhaust fans of the Seymour disc type, located in the attic. One having a 4-ft. wheel is driven by a 5-hp motor, and two having 3-ft. wheels by 3-hp motors. Of the motor-driven book-lifts, three will raise 25 pounds at the rate of 150 ft. per minute, and the other two

will carry 100 pounds 100 ft. a minute. All are provided with electric control whereby the cars may be brought to any floor by pushing the button corresponding thereto, if all of the doors into the shaft are closed. The opening of any one of them breaks the circuit and stops the car. The passenger elevator has a travel of about 52 ft. and will carry a maximum load of 2,000 pounds at 200 ft. per minute, or an average load of 1,200 pounds at 250 ft. per minute. In addition to the customary slack-cable safety device and automatic top and bottom stops, the shaft was made tight at the bottom to afford an air cushion to catch the car in case of a failure of the other protections. After its installation the elevator was tested by loading the car with a weight of 2,000 pounds, and allowing it to drop from the top of the shaft, which it did without receiving any injury.

The switchboard is about 6½ ft. wide, 7½ ft. high and consists of two panels of white Italian marble. A single set of bus-bars on the back of the board serves for both light and power service, being connected to each generator through a single-throw, 3-pole switch, protected by a single-pole circuit-breaker. The instruments include two ammeters, one for each machine; a voltmeter, which by a multiple-point switch may be connected to either generator, and a recording station wattmeter. The feeder circuit switches are symmetrically grouped on both panels between the dynamo switches and the indicating meters. Three are for power and the remainder for light. The lighting feeders are supported on porcelain knobs 4 ft. apart and lead from the switchboard to and up the elevator shaft. These include two sets of conductors for the first floor and one set for each of the floors above. From a cut-off box near the shaft at each floor the distributing circuits are taken to the various marble panel boards, seventeen in all. In determining the sizes of the conductors, the maximum loss of potential allowed between the switchboard and the lamps was 5 volts: 3 in the mains, 1 in the sub-mains and 1 in the distributing circuits.

Mr. James M. Seymour, Jr., of Newark, N. J., was the consulting engineer in behalf of the library trustees. The contractors for the various parts of the equipment were as follows: The Philadelphia Steam Heating Company, for the heating system and steam pipe work; Gillis & Geohegan, of New York, for the fans and tempering coils; the Crocker-Wheeler Company, of Ampere, N. J., for the electric generators, and Blake & Williams, New York, for the electric wiring. Mr. George A. Warren is the operating engineer of the plant.

New Form of Resistance Box or Wheatstone Bridge.

The accompanying illustration shows a new form of resistance box or Wheatstone bridge, being placed upon the market by the Leeds & Northrup Company, 259 North Broad Street, Philadelphia, Pa. The instrument has been designed primarily for the rapid and accurate work required in submarine cable testing, but it is, however, adapted to any kind of resistance measurements required to be made in laboratories. As will be seen, the rheostat is the decade plan, consisting of four dials. Fig. 2 gives a sectional view taken of one section of the dial, and shows the brushes which make contact with the segment. There are eight of these brushes, of which four have an end bearing against the upper portion of the inside of the segment and four have an end pressure against the lower part of the inside of the segment. By this construction all strain is removed from the center bearing and the "feel" of the switch handle is the same throughout the entire sweep of the brushes over the segment. The edges of the brushes bearing against the segments do not lie in a line at right angles in the length of the brush, but are inclined at the small angle, thus obviating all danger of the brushes' edges cutting grooves in the segments. The contact resistance of the brushes with the segment to the resistance of the brushes themselves is on an average of about .0007 ohm, an entirely eligible quantity.

FIG. 1.—NEW TYPE OF WHEATSTONE BRIDGE.

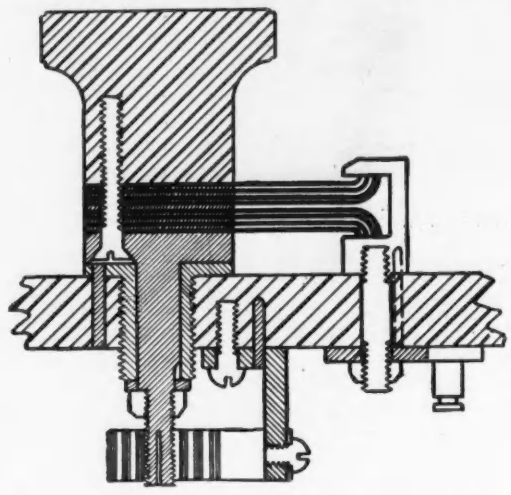


FIG. 2.—SECTIONAL VIEW, SHOWING CONTACT BRUSHES.

The arrangement of ratio coils has been adopted from a construction developed in Germany, but not heretofore used in this country. According to this arrangement, all of the ratio coils have one of their terminals connected with the common center, which corresponds to the bar marked *C*, in Fig. 3. The other terminal of the coil is connected to a separate plug, shown in the center row of Fig. 1. By this means even and uneven ratios may very simply be obtained, and the arrangement enables the user of a bridge to discover and check any errors in the adjustment of the coils, if such exist. Furthermore, by using more than two plugs and joining certain of the coils in parallel combinations, a large variety of ratios may be obtained. This system offers a convenient method of measuring the sensibility of a bridge and galvanometer combination. Another advantage is that errors due to plug contacts are practically eliminated, since only two plug contacts enter the circuit, while with even ratios is only the difference in the resistance of these contacts they can affect the result.

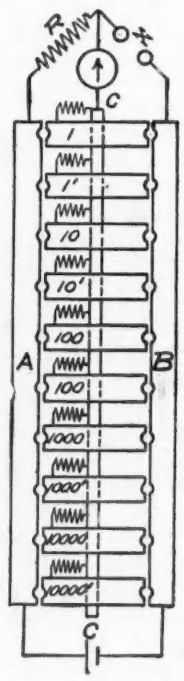


FIG. 3.—SCHEME OF CONNECTIONS.

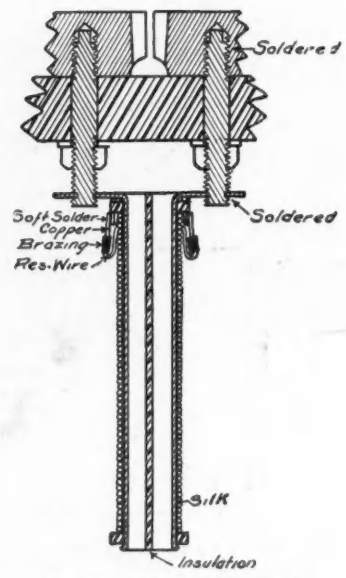


FIG. 4.—RESISTANCE SPOOL.

The spools upon which the resistance wire is wound are metal tubes (Fig. 4) in insulated metal halves, which also serve as terminals. The insulation between the two metal halves is made very perfect and the construction is such that the heat generated in the

spool is rapidly dissipated, part passing off by radiation from the inside of the spool, part by radiation from the outside and another portion by conduction through the metal of the spool into the terminal soldered thereto. The makers guarantee an accuracy of adjustment for the ratio coils of 1/50 of 1 per cent., and for the rheostat coils of 1/25 of 1 per cent.

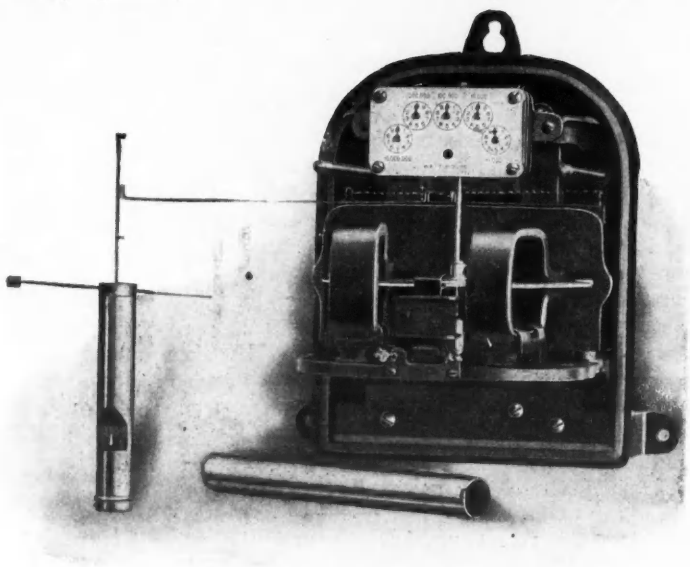
Cross Arm Manufacturers Organize.

The manufacturers of cross arms, pins and brackets used in electric line construction, held a meeting in Indianapolis, Ind., recently and organized an association to be known as the National Arm, Pin and Bracket Association. Forty members signed the roll, including some of the largest manufacturers in the country. The manufacturers disclaim any intention to control prices, but desire the bringing about of greater uniformity in the size and style of arms. It is said that the adoption of a standard was the main purpose of the organization. There are about 150 firms engaged in the manufacture of arms, pins and brackets, and it will be the purpose to bring them all into the association. The following officers were chosen: President, W. H. McElwee, Ronda, N. C.; vice-president, Daniel Ravenel, Franklin, N. C.; secretary, J. B. Majors, Madison, Ind.; treasurer, R. L. McQuat, Indianapolis, Ind.

Portable Torque Balance.

To enable station managers to measure torque when purchasing meters, the General Electric Company has designed a portable "Torque Balance" for measuring the torque of any motor meter. The stationary element consists of a light cylinder mounted on a supporting base which may be secured to a suitable support by means of a small center screw. The balance or weighing element is composed of two parts—a horizontal arm carrying the standard weight, and a vertical arm. The upper half of the vertical arm is provided with three small loops, while the lower half extends through the cylinder and terminates in a small index or pointer moving in the opening in the side of the cylinder. The entire moving system is suspended by means of highly polished pivots and bearings, insuring great sensitiveness.

The balance is connected, by means of a small link of finely-drawn wire, to a lever provided with three small loops similar to those of the vertical arm of the balance. This lever is attached to the meter shaft by a friction clamping sleeve. Two standard weights of one gram and one-quarter gram are supplied with the instrument and are secured in small receptacles conveniently located in the base holding the cylinder.



PORTABLE TORQUE BALANCE.

After placing the balance in position, the weight should be so chosen and the connecting link so placed in the loops, that when approximately full load current is passed through the meter, the pointer will rest on zero. One or two trials are sufficient to determine the proper weight and loops to be used in order to measure the torque of the meter under test. When the device is approximately balanced, final adjustment to a condition of exact balance may be made by increasing or decreasing the load. It will be found that the most satisfactory and most nearly accurate tests are secured when the meter is loaded to about its normal capacity.

The torque or turning movement is expressed by means of a simple formula, in "gramme millimetre" units, i. e., the torque produced by one gram acting at the end of an arm one millimetre in length. The entire mechanism folds compactly and is enclosed in a nickel-plated metallic case 7¼ in. x ¾ in.

Large Magnet for Oculists' Use.

In order to remove splinters of steel and other magnetic particles from his patients' eyes, Dr. E. C. Rivers, a prominent oculist of

LARGE MAGNET FOR OCULISTS' USE.

Denver, Colo., had constructed the special magnet illustrated herewith. Several very successful operations have been performed with this magnet. In one case Röntgen rays had been used and other methods tried in the endeavor to locate steel particles in a man's eye, but without success; with an application of this powerful magnet, however, it is stated that the portion of the eye containing the steel bulged out and with a careful incision they were easily removed. In case of a fresh wound where the filament has not had time to form over the opening, the splinter is readily drawn out through the hole it made in entering.

The machine was built by the Carstarphen Electric Company, of Denver, after designs of W. P. Carstarphen, Jr., president of the company. It consists of a double magnet mounted on a handsomely finished brass pedestal, which in turn is supported on a polished oak stand. The case of the magnet is a solid forging of Norway iron, four inches in diameter and 29 inches long. It weighs 108 pounds and is supported on trunnions which rotate on a pivot, so that the pointed ends of the magnet may be raised or lowered or swung around in any position. The device is held fast in the desired position by locking levers.

The coils are 10 inches in diameter and are wound with No. 12 copper wire. The connections are such that with the coils in series the magnet may be operated from an ordinary 220-volt circuit, taking in this case 6 amp., or 1.32 kw of energy. By connecting the coils in parallel the magnet may be operated on a 110-volt circuit, taking 12 amp.

For regulating the current, a rheostat, made with slate leads and German silver resistance wire, is employed. This device stands on the floor and is regulated through eight variations by the oper-

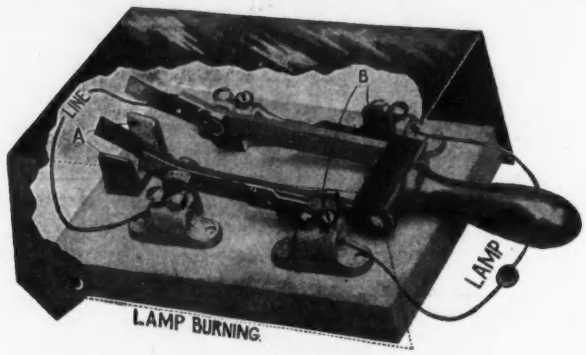
ator's foot. When the foot is taken off a trigger arrangement automatically cuts off the current. Perfect control of the current is thus given the operator while leaving both hands free for his surgical work.

The magnet is calculated to exert an attraction of 150 pounds per square inch of contact. The pointed ends are removable, and when taken off and ends an inch square substituted, the magnet will support the weight of a 150-pound man. The weight of the apparatus entire is 350 pounds.

The accompanying illustration shows the method of applying the magnet, the operator in this case being Mr. Carstarphen, the designer of the machine. It may be added that the wireless telegraph system that is in successful operation between Santa Catalina Island and the California coast was built in his shop.

Cut-Out for Series Arc Lighting Circuits.

The Ozark cut-out illustrated herewith is adapted for voltages up to 5,000 volts (at 10 amp.) and particularly intended for direct-current series arc lighting circuits. With this cut-out the circuit is never broken, for in the operation of cutting out a lamp, before the lamp circuit contacts are broken, a by-pass connection is made, so that a continuous path is always provided and consequently no arcing can occur. Ordinarily the cutting out of a grounded lamp



CUT SHOWING HOOD.

when there are two grounds, will endanger a switch and all lamps between the two will remain out; with this cut-out, however, one of the grounded lamps can be cut out while the others on the circuit will continue burning, thus saving in fines for lamps out.

A series of tests of this switch made by the Illinois Engineering Company, of Chicago, showed it to be indestructible under any conditions which might arise in actual service, including the handling of a 5,000-volt current or the equivalent of a hundred-lamp circuit on one switch. The switch is small and compact, so that it may be placed inside a post, where cast-iron posts are used. The metal hood protects it from moisture and shields the live parts.

The Ozark cut-out is handled by Hart & Company, of Chicago, who soon expect to place on the market a modification with long blade for alternating-current circuits.

Enlargement of New York Subway Power House.

The New York rapid transit subway commissioners have purchased an additional lot, 108 x 200 ft., on which to build an addition to the power house now building on the space between Fifty-eighth and Fifty-ninth Streets and Eleventh Avenue to the Hudson River. The addition will make the plant the largest and most expensive in the world. It will cost altogether $7,000,000, and will be capable of generating 132,000 hp. In the boiler plant at first will be set up seventy-two boilers, each capable of producing 500 hp. The fuel for these boilers will amount to 1,000 tons of coal a day. The coal will be carried by belt conveyors to a storehouse 80 ft. above the ground, with a capacity of 25,000 tons. The ashes from these thousand tons a day will be carried by cars to scows lying in the river. The walls of the building will be of cut granite and terra cotta, and pressed brick. The windows will be fitted with steel frames and the roof will be of terra cotta and glass. There are five brick chimneys to rise above the plant. They are unusual in their construction, in that their bases will rest on steel platforms about 40 ft. above the floor of the power house. Building the stacks from the ground up would have occupied a great deal of valuable space in the middle of the building. The chimneys will reach a height of 265 ft.

The Kellogg Telephone Company's Strike.

Although we have from time to time reported the various developments in this celebrated strike, a brief resumé of its course may here be given. In July, 1902, only 5 per cent. of the Kellogg workmen belonged to unions, while in April, 1903, only 10 per cent. were non-union men. Nevertheless, in the first week of May in this year a strike was called for the sole purpose of securing the complete unionization of the Kellogg plant, there being no quarrel about hours or wages, and the very fact that the percentage of union men had increased rapidly was convincing proof that no discrimination had been practised. In subsequent stages when the matter came before the courts, Judge Holdom declared that an agreement to employ only union men is of doubtful legality, against public policy and in conflict with the spirit of our government and of our institutions; and the Appellate Court in sustaining Judge Holdom, said that such an agreement would conflict with public policy, in that it would restrict the lawful right of the individual either to work for a livelihood or to employ whom he chooses. Two weeks after the strike was called, the company announced that the vacancies were to be filled, and that each employee was to be treated strictly on his merits. The period of violence now began. The men employed were intimidated and assaulted, and on May 25, about three weeks after the strike was called, Judge Holdom issued an injunction ordering the strikers to desist and refrain from threats and further violence, from picketing and from patrolling, and from in any way interfering with the company in carrying on its business in its usual and ordinary way. Acts of violence, however, continued to be committed, and Judge Holdom fined sixteen men for violating this injunction. Certain employees sued certain strikers for damages, while similar suits were instituted by the company itself, against certain unions as unions, and the Grand Jury indicted some strikers for assault. Another stage of the strike dates from June 24, when the teamsters of the company doing the Kellogg Company's hauling, went on a sympathetic strike. In this case, the transfer company had a contract with the truck drivers' local, but the Joint Council, disregarding this contract, ordered the strike. Following it, for two weeks, the plant of the Kellogg Company was blockaded, and Judge Holdom in vain sentenced violators of his injunction to fines and imprisonment. The Kellogg plant stood invested, guarded by policemen and detectives; employees were daily assaulted, plate glass windows were smashed and telephone wires cut. Finally, on July 8, the Kellogg Company sent a wagon to the freight station guarded by police, but on July 11, when wagons thus escorted arrived at the depot the freight men refused to handle Kellogg products. These men were immediately discharged, whereupon an officer of the freight handlers' union called on the teamsters to join with the freight handlers in a general sympathetic strike. The teamsters refusing their aid, the freight handlers went back to work. The Kellogg Company, however, still met much difficulty in transporting their products. Union teamsters blocked the streets whenever a Kellogg wagon appeared, which obstruction, together with assaults on the drivers, made police protection necessary. The teamsters also endeavored to enlist in their aid public officials. They appealed to Superintendent Cook, of the West Park system, to prevent the Kellogg Company from running its wagons on the boulevards, and an alderman presented a resolution in the council to the effect that in labor disturbances the police should remain "neutral." On July 20 Judge Holdom enjoined the teamsters from committing unlawful acts in injury of the Kellogg Company's business, and on July 23 the teamsters went back to work. The Kellogg Company is now running its plant almost at full capacity and is conducting its business as though no strike were in progress. The unions, however, have not given up the struggle, and the Chicago Federation of Labor has voted them $15,000 a month.

Wireless in the Navy.

During the recent naval manœuvres the value of the wireless telegraph has been demonstrated to the satisfaction of the naval officers. Under ordinary conditions it would have been several hours before the *Olympia* could have communicated her discovery of the invading enemy to any other ships of the squadron, even though she could have made a run for it, which the rules prohibited. But by the aid of wireless system not only was she able to inform the admiral of the approach of the enemy, but Admiral Barker's flagship, the *Kearsarge,* transmitted the message sent by the *Olympia* from ship to ship along the whole length of the coast from Mount Desert Rock to Cape Ann.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—It is not at all an unusual thing for securities in Wall Street to show an advance during the month of August, especially as soon as the conditions of the crops become favorably authenticated. It is still possible that some such turn may be given to the market, as August is still young, but it will take a good deal for the general list to recover from the staggering blows which have been administered to it during the first ten days. Just what is the matter with the market nobody seems to know, although Standard Oil influences are credited in many well-informed quarters with a strongly manifested desire during the last six months to put the market down and keep it down, in order to avoid more serious disturbances later, which would have resulted from a prolongation of the period of speculation and fancy prices. Be this as it may, there was hardly a stock which did not rule materially lower throughout the week, and it may be said that the depression has continued into the present week, although there have been some signs of stiffening associated with the presence in the street of a great many small investors, who have been picking up at wonderfully low prices a lot of the stocks that overburdened rich men and plungers have had to drop from sheer inability to carry the load. In view of the remarkable decline in prices, it is surprising that there have been so few Wall Street failures, but only one or two concerns have gone to the wall and none of these are of first-class importance. One of them was coupled last winter with the desperate and disgraceful drive against the New York Metropolitan Street Railway Company, so that its punishment is viewed in some electrical quarters with complacency. Money throughout the week has ruled fairly low, and the market was by no means excited, although naturally bankers were looking closely at loans and were more inclined than ever to throw out speculative stocks when offered as collaterals. 5 to 5½ per cent. was about the rate for long-term meney, and 1½ to 2½ per cent. for call money. The quotations given below are those for August 11, and in view of the rally will not mark, therefore, the extreme declines which were experienced during last week.

NEW YORK.

	Aug. 4.	Aug. 11		Aug. 4.	Aug. 11
American Tel. & Cable	77	77	General Electric	157	154
American Tel. & Tel	130	129⅝	Hudson River Tel	..	..
American Dist. Tel	25	25	Metropolitan St. Ry	116⅛	111
Brooklyn Rapid Transit	42⅛	41	N. E. Elec. Veh. Trns	..	5
Commercial Cable	149	..	N. Y. & N. J. Tel	..	..
Electric Boat	15	13	Marconi Tel	..	1¾
Electric Boat pfd	35	39	Western Union Tel	83⅛	81⅝
Electric Lead Reduction	1⅜	2	Westinghouse com	163	..
Electric Vehicle	5	7	Westinghouse pfd	165	..
Electric Vehicle pfd	8	10			

BOSTON.

	Aug. 4.	Aug. 11		Aug. 4.	Aug. 11
American Tel. & Tel	130	129⅜	Western Tel. & Tel. pfd	83	83
Cumberland Telephone	..	..	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum	..	235	New England Telephone	120*	127
General Electric	..	154	Westinghouse	85	..
Western Tel. & Tel	13	13	Westinghouse pfd	85	..

PHILADELPHIA.

	Aug. 4.	Aug. 11		Aug. 4.	Aug. 11
American Railways	..	43	Phila. Traction	94½	94¼
Elec. Storage Battery	57	..	Phila. Electric	5⅛	5⅛
Elec. Storage Battery pfd.	58⅛*	60	Pa. Electric Vehicle	..	..
Elec. Co. of America	7¾	7⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Aug. 4.	Aug. 11		Aug. 4.	Aug. 11
Central Union Tel	..	..	National Carbon pfd	90	92
Chicago Edison	142	..	Metropolitan Elev. pfd	..	55
Chicago City Ry	165	165	Union Traction	3⅛	..
Chicago Tel. Co	120	..	Union Traction pfd	30	..
National Carbon	23*	..			

*Asked.

NEW YORK TRACTION FINANCES.—A great deal of public interest is manifested in the recent large trolley deals on Long Island. Discussing this situation, the *Wall Street Journal* says: "The liquidation in the local traction stocks has resulted in important changes in the ownership of these properties, and has special significance in view of the recent purchase of the trolley lines in Queens County. These trolley lines were bought by a syndicate which is said to include some Standard Oil people and some Philadelphia and Western people. This purchase is in line with deeply laid plans for the concentration of all the trolley and electric light interests of Greater New York into the hands of the people who at present control the Interborough Company. It seems that the whole impulse in the present movement turned upon the acquisition of Manhattan. The Metropolitan Securities Company was formed with the ultimate view of first securing possession of Manhattan, then of the Subway, and then of Brooklyn Rapid Transit. The deal was interfered with by the Interborough people securing control of Manhattan, taking it away from Metropolitan. Since then Metropolitan has been weakened considerably by the loss of Manhattan, and also by the litigation against its method of financing. This liquidation in Metropolitan has been taken advantage of by the Interborough people to secure a very strong holding of Metropolitan stock. The same people, taking advantage of the general condition of the market, have also decided that it might be an opportune time to get control of Brooklyn Rapid Transit. They have been helped in the latter case greatly by the disruption of the old Brooklyn Rapid Transit pool, which was forced to let go, and in letting go forced the price down to 38. On the decline, vast numbers of stop orders were also reached, so that it has been a comparatively easy matter to secure a very large holding of Brooklyn Rapid Transit stock, if not actual control. In the execution of stop orders, the sales are not reported on the tape, so that the transactions in the stock have been much larger than reported on the tape."

PROSPECTS OF DETROIT EDISON.—The president of the Detroit Edison Company, in a letter to a large holder of Detroit Edison bonds, states that the construction of the new generating station promises to be completed early next year, and that extensions and additions to the underground conduit and distributing systems are progressing rapidly. The growth of business has been restricted by the capacity of the present plants. The operating expenses during the five months of this year have been much greater than for the corresponding period of last year, because of the higher price for fuel, materials and labor, and because of the excessive cost of maintenance and repairs crowded into these months to enable the operating force to devote their time later in the year to the new construction, and also because the excessive loads, now carried by the several separate generating stations, have been unfavorable to economical operation. For the five months ending May 31, the gross earnings increased $26,808, while operating expenses increased $32,111. The actual net income for these five months was $89,832, and interest requirements were $38,301, leaving an actual surplus of $51,531. The above showing indicates that the interest on the Edison bonds is well secured. Some people hesitate to put money into local securities in Detroit because of fear that politicians may at any time assume an aggressive hostile attitude toward corporations in that city. On this point it may be stated that the city of Detroit has done its own public lighting for many years, but has not been responsible for the granting of other franchises. No franchise of any character for lighting is now held by other interests than the Detroit Edison Company and the Edison people believe that it is not likely that the territory which is so completely occupied will be invaded by others.

MEXICAN TELEPHONE ANNUAL.—The report of the Mexican Telephone Company for year ended February 28, 1903, is issued. The income account has already been published, showing in Mexican currency gross earnings of $246,368; net $111,997. It is said: "Our present concession for the City of Mexico will soon expire. The new application is being energetically prosecuted and a prompt renewal is assured us. The new concession will, however, be seriously burdensome to the company, as the Mexican government seems likely to demand the discontinuance of the aerial system and to require the adoption of an underground system, which will entail a heavy expenditure by the company." President Charles H. Rollins further says: "Business in general throughout the republic has continued prosperous, although the continual rise in exchange and abnormal fluctuations during the latter part of the year have, beyond a doubt, hampered this increase to a certain extent. The gain, per subscriber, in gross earnings for the year, as compared with the previous year, is .2075, and the increase in total expense is .6618, a decrease in net receipts, per subscriber, of .4543. This decrease is principally due to increase in expense in Mexico City and loss caused by opposition in Queretaro."

NEW YORK CONSOLIDATED GAS.—Stockholders of the Consolidated Gas Company were notified last week of the long-expected issue of new capital stock. The privilege of subscribing to the stock is given to stockholders of record on August 27. They may subscribe to the extent of 9 per cent. of their holdings, and the price which they will be asked to pay is $150 a share. The privilege to subscribe expires at the close of business on September 9 and subscriptions must be paid on or before September 15 at the Na-

tional City Bank. No subscriptions will be received on holdings of fractional shares, but scrip will be issued for the same, which will be convertible into stock in multiples of $100 until December 31 next, after which date unconverted scrip may at the option of the company be redeemed in cash at the rate of $150 per share. In the official notice to the stockholders it is stated that the authorized capital stock is $80,000,000, of which there is now outstanding $72,917,759. Nine per cent. of the latter amount would be in round numbers $6,500,000. The object of the stock issue is said to be to meet the cost of important improvements in the gas system of the company, which is also the controlling power in the electric light field in New York City.

PLANT FOR PRINCETON, N. J.—It is stated from Princeton, N. J., that plans are being made there for a large steam heating and electric lighting corporation, to be known as the University Power Company. A plant which will provide heat and light both to the University and the town, and probably the outlying districts will be installed. A few days ago the new power company presented an ordinance to the Common Council granting a franchise for the use of the streets for conduits, trenches and manholes, through which the electricity and steam might be properly distributed. The ordinance, after being amended, was passed by sections on the second reading, and will be finally passed on this week. The company will be incorporated with a capital of $500,000, to furnish steam as well as electricity to residents of Princeton. The ordinance will remain in effect for fifty years, and during this time the Borough Council will exercise the right to see that every condition named in the ordinance is properly carried out. The Princeton Lighting Company, which will be affected by the new company, have requested a postponement of the consideration of the new company's ordinance.

AMERICAN TELEPHONE HOLDINGS.—It is stated from Boston, in connection with the resignation of Vice-President Cummings, of the American Telephone & Telegraph Company, who, it is understood, represented New York interests, that New England people, having sold nearly all their other investments, such as Burlington, Atchison, Union Pacific and other Western railroads, held tenaciously to their telephone investments, and have been the large buyers of the new stock issue, while New York has been the seller of substantially all of the American Telephone & Telegraph shares that were placed there a year or two ago. It is understood that the City Bank, the Standard Oil interests and also the J. P. Morgan interests have parted with substantially all their telephone shares. At one time it was reported that the Morgan interests represented as much as $15,000,000 in American Telephone & Telegraph. New England having parted with her Western railroad interests, is now competent to carry the telephone interests of the United States as represented in American Telephone & Telegraph.

GENERAL ELECTRIC GOSSIP.—The evening edition of the *New York Sun* had the following item of gossip last Saturday: "One of the rumors that find a ready circulation in the street is to the effect that within the past few days a big block of General Electric stock changed privately. It is said that much of this stock was acquired by an individual prior to the taking of an option on the Stanley Company by a certain group of capitalists and that the balance of it was secured later when the Stanley Company passed to the control of the General Electric Company. It is not suggested that any speculative necessities forced the sale of the stock, nor can it be accepted authoritatively that there was such a sale. Still, such is the gossip and certain incidents of the week lend some color to it."

TEXAS TELEPHONES.—The independent telephone lines, known as the Commercial Telegraph & Telephone Company of Texas, have passed into the hands of H. T. Huntington, with Frank B. Smith, the originator of the independent system of the State, in charge. Mr. Huntington has acquired the system for approximately $400,000 and intends to invest $400,000 in improvements and in extension in Texas and later extend them over the Southwest.

THE YOST ELECTRIC MANUFACTURING COMPANY, of Toledo, Ohio, has increased its capital stock from $75,000 to $200,000 in order to take care of its rapidly-increasing business. Most of this increase will be taken up by its present stockholders. Although the company completed a new factory to increase its capacity only last May, it is found necessary to again increase the output on Yost sockets, and a number of new articles will be added to the line.

CONSOLIDATION AT ALTON, ILL.—On the 30th of July, 1903, the Alton Railway, Gas & Electric Company and Alton & East Alton Railway & Power Company were consolidated under the name of the Alton Light & Traction Company, with authorized capital $1,000,000; preferred stock issued, $500,000; common stock issued, $150,000.

PURCHASE OF ITHACA TROLLEYS.—George F. Archer, of Camden, N. J., has completed a big transaction for Philadelphia capitalists in the purchase of the entire street railway system of Ithaca, N. Y. The price has not been made public.

Commercial Intelligence.

THE WEEK IN TRADE.—As might be expected at this season of the year, general trade is quiet, but on the whole conditions have remained favorable and consumption has proceeded on a large scale. It would be strange, indeed, if the downward fluctuations in Wall Street connected with the depression there did not have some effect upon commercial interests and dampen the ardor of general trade, but anything which makes for prudence and sobriety has its compensations, and in view of the enormous bulk of business that has been done for a few years past, a little slackening off might be quite other than evil. At the same time, some of the railroads report themselves busier than ever, and their general condition improved, as evidenced by the fact that the Canadian Pacific has increased its dividend rate, just when Wall Street is feeling bluest, while its figures of traffic show it to be justified in giving a larger return to the stockholders. Moreover, the crop reports issued by the government are on the whole of an agreeable tenor, wheat and corn promising heavily and being not far short of high-water mark in regard to both. In fact, so far as crop conditions have anything to do with trade and commerce, the outlook is very satisfactory. The copper market has remained simply inactive and weak, and lake and electrolytic have been about 13¼c., with casting ¼c. lower. In the iron and steel market, conditions are pretty steady and consumption has continued large, with the certainty that should it slacken off at all the large imports of the last year could hardly be repeated. The returns for the past seven months of bank clearings and of trade failures are encouraging, the clearings for July being next to January the largest for any month this year, and only 4 per cent. less than in July, 1902, due simply to smaller stock speculation. Business failures also for July were 7 per cent. less than in July, 1902, and 8 per cent. less for the period of seven months. The only inference from this can be that traders and bankers are alike careful and have not been spoiled by the long period of prosperity, which is happily still with us.

THE PETERBOROUGH HYDRAULIC POWER COMPANY, of which Senator George A. Cox is president, is building a new power plant on the Otonabee River in the town of Peterborough, Ont., Canada, which will be equipped with the following apparatus recently purchased from the Westinghouse Electric & Manufacturing Company. A 1,500-kw, 2,240-volt generator, 60 cycles, and running at 150 r.p.m., to be direct-connected to water wheels; also two 125-volt, direct-current, direct-coupled exciters of 75-kw capacity each, together with switchboard consisting of a large generator panel and two exciter panels. This power house, when completed, will be an unusually fine one and is to furnish power to the Peterborough Mill of the American Cereal Company, owned by the Quaker Oats Company. Power will be supplied to several other manufacturing plants in the town, and also to the Peterborough Light & Power Company, which does the electric lighting and small power business in Peterborough.

STROMBERG-CARLSON TELEPHONE PLANTS.—The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., and Chicago, Ill., has recently sold switchboard and entire exchange equipment to the Lewiston Telephone Exchange Company, of Lewiston, Minn. They have also sold additional switchboard apparatus to the Minot Light & Telephone Company, of Minot, No. Dak. The Madelia Telephone Company, of Madelia, Minn., have recently bought their entire switchboard equipment from the Stromberg-Carlson Company. The Citizens' Telephone Company, of Mankato, Minn., have recently purchased a two-position toll line board, equipped with selective lock-out and toll line apparatus. The company have also recently sold twenty selective lock-out telephone equipments to the Independent Telephone Company, of Winthrop, Minn.; also a quantity of telephones to the Farmers' Mutual Telephone Company, of Volga, So. Dak.

CEMENT ENGINEERING.—E. P. Roberts & Co., of Cleveland, Ohio, consulting engineers, have opened a department of cement engineering and are now prepared to take entire charge of the designing and supervision of the construction and operation of cement plants. This firm has been in business for ten years and has large experience in electrical, mechanical and civil engineering, having had the consulting and supervising work for a great number of electric railways, electric lighting and power plants, manufacturing plants, etc. The cement department opens up a new field and the services of Mr. George S. Perkins, M. E., have been secured to look after the work. Mr. Perkins is a graduate of Stevens Institute of Technology, class of 1891, in the course of mechanical engineering and has had an extensive experience in the designing and constructing of cement plants.

AUTOMOBILE MANUFACTURING.—Mr. George H. Day, president of the Association of Licensed Automobile Manufacturers, states that the 26 members of the combination make not less than

90 per cent. of all the gasoline motors in the United States and that they are now prepared to prosecute for infringement of patents all the manufacturers, agents or users of gasoline motors not made by them. There are 120 auto manufacturers who are outside the fence. Up to date 26 important manufacturers and agents of gasoline automobiles have joined the auto combination, and have paid their dues of $4,500 each, but the 120 manufacturers, agents and importers who have thus far not associated themselves with the combination, do not accept as final the claim that the Selden patents bar them from manufacturing or using automobiles with gasoline as the motive power.

THE METAL "SELIUM."—German papers report the discovery by Edward Mollard, a Frenchman, of a new metal called "selium." According to the *English Mechanic,* the discoverer claims that selium costs but one-twelfth as much as aluminum and is lighter and stronger. It does not rust, and is, therefore, suitable for use in shipbuilding, for the manufacture of pipes, and for railroad construction. On account of its cheapness—and as it is capable of a fine polish, resembling nickel—it would be desirable for manufacturing cooking utensils. Its density is 2.6 and its hardness not quite that of iron, but greater than lead or zinc. Its power of resistance is said to be greater than that of iron, but less than that of steel. The melting point is at 1,600° C. In melting it contracts somewhat, but molding in forms is not impossible. It will be well, however, to await more definite information concerning its properties.

THOMAS H. DALLETT COMPANY.—The well-known concern of Thomas H. Dallett & Co., of Philadelphia, have been reorganized and incorporated as the Thomas H. Dallett Company. The officers elected are: President, Thomas H. Dallett; vice-president and general manager, Ernest C. Bliss; secretary and treasurer, E. C. Clay. W. H. Van Sickel, lately New York representative of the Under Feed Stoker Company of America, and well known in the pneumatic tool industry, has been appointed superintendent. The company will increase the capacity of their plant, located at York Street and Sedgeley Avenue, and while continuing the manufacturing of their belt and electricity-driven portable drills, deck planers, etc., will devote special attention also to the manufacture of Dallett pneumatic tools.

KELLOGG TELEPHONE CONTRACT.—The Kellogg Switchboard & Supply Company, Chicago, has been awarded a contract by the Pittsburg & Allegheny Telephone Company for a 3,000-line, common-battery, multiple switchboard for McKeesport, Pa. The present equipment is to be 1,000 lines. The Kellogg Company has also received an order from the National Telephone Company, of London, England, for an 800-line, common-battery board for Lavender Hill, London. A contract has also been awarded to it for an exchange equipment at Pasadena, Cal., including a 7,200-line switchboard with 1,500 lines equipped. This contract includes the telephone instruments.

POWER HOUSE CONTRACTS.—The Indianapolis & Cincinnati Traction Company has awarded contracts for the construction of its power house at Rushville and work on the building will begin in a very short time. The contracts include the erection and the equipment of five sub-stations along the road. The Westinghouse Electrical & Manufacturing Company received the contract for the electrical apparatus and the Babcock & Wilcox Company was given the boiler work. The engines will be supplied and set up by the Fulton Foundry & Machine Company, of St. Louis.

STEEL MAKING BY ELECTRICITY.—Canadian capitalists are said to be interested in the electric furnace for making steel, invented by Marcus Ruthenburg, of Philadelphia, already noted and described in these pages. The inventor claims for his furnace that it will cheapen the process of steel making 20 per cent., and turn out a product equal to Bessemer. Electrolytic steel, he says, is an assured fact. Arrangements have been made by the Canadians for giving the process a commercial test near Niagara Falls, where electric power is cheap and plentiful.

PELTON WATER WHEELS.—We have the following from the Pelton Water Wheel Company, of San Francisco, Cal.: "We note in your Export issue of August 1st, on page 204, that mention is made in the Electric Light and Power notices, that the Rock Creek Power & Transmission Company, of Baker City, Ore., has contracted for De Remer water wheels for direct-connection to their 400-kw, three-phase alternators. This is an error, as we have the contract for supplying all water wheels and governors for this plant."

APPARATUS WANTED.—The Kenny Electrical Manufacturing Company, Nassau-Beekman Building, New York City, Paul T. Kenny, manager, etc., is in the market for a 600-hp vertical or horizontal compound condensing engine, as well as a direct-connected dynamo to hitch to same, either 220-volt, direct-current, or two-phase, 60-cycle. Details of second-hand outfit will be welcomed. The concern will also be shortly wanting a center-crank, direct-connected, 115-volt outfit, of 75 to 100 kw, 80 pounds steam pressure.

MOTORS, FANS, ETC., FOR INDIA.—The New York Export & Import Company, 133-137 Front Street, New York, which concern represents the interests of the Bullock Electric Manufacturing Company and the Dayton Fan & Motor Company, in British India and other Asiatic countries, has secured some substantial orders for motors, fans, etc. The same concern has also orders on hand for machine tools for installation in Indian railroad shops, etc.

CONVERSION OF AUSTRALIAN STEAM ROAD.—There is an extreme likelihood that part of the Sydney suburban traffic of the New South Wales government railways will be handled in the near future by electricity. Mr. Charles Oliver, the chief railroad commissioner, is agitating the matter of conversion. In the first instance it is proposed to change the motive power of the North Shore line. This section is 13 miles in length.

MORE ELECTRIC TRACTION FOR WEST AUSTRALIA.—An extensive electric traction system is to be constructed in West Australia. The lines will operate in and around Essendon, Flemington and Kensington. A. E. Morgans, the well-known West Australian mining man, is primarily interested in the project. A. E. Rodgers, general manager of the Perth & Kalgoorlie tramways, is drawing up the plans, etc.

UNITED STATES CARBON COMPANY.—The affairs of the United States Carbon Company, which failed about a year ago, were wound up at Cleveland, Ohio, on August 11 by the court's acceptance of the receiver's report and by the latter's discharge. The property was sold for $87,000, and the sum was used in paying off creditors, netting them a trifle more than 36 per cent. The total due creditors was $222,864.

BIDS WANTED FOR PLANTS.—The city of Monroe, La., will receive bids until August 17 for direct-connected engine and alternator, arc light transformers, etc. C. A. Downey is acting mayor. The Board of Public Service of Cleveland, Ohio, will receive bids until August 13 for two direct-connected generators and switchboard, to be installed in the engine house of the Kirkland Street pumping station.

POWER DAM CONTRACT.—The officials of the New Haven Railroad announce that a contract has been closed with the B. D. Pierce, Jr., Company, of Bridgeport, for a dam at Borden, Conn., which will make a lake of 30,000,000 gallons of water, to furnish motive power for the electric roads of that neighborhood owned by the New Haven road. The dam will be 25 ft. high and 175 ft. long.

ELECTRICITY FOR DURBAN HARBOR.—Electricity is to be used in place of hydraulic power for the purpose of operating cranes, elevators, conveyors, etc., at the important harbor of Durban, South Africa. It is not yet decided whether polyphase or continuous current will be employed. The initial equipment will have a capacity of about 300 hp. Mr. George Stobie is drawing up the plans, etc.

MEXICAN HYDRAULIC PLANT.—The hydraulic power plant of the Tezuitlan Copper Company, Mexico, is to be enlarged and contracts for equipment, etc,, will be let. The existing plant has a capacity of 666 hp. The current is transmitted to the company's mines four miles distant. The present equipment included Pelton water wheels. Another 333-hp outfit will be installed.

ELECTRIC DRILLS FOR THE ARGENTINE.—The export house of Kates & Bok, 79 Wall Street, has some orders for electric drilling equipments for shipment to the Argentine Republic. A good deal of new business now seems to be offering from that part of the world, and it is to be hoped that American concerns or their representatives will be smart enough to capture the orders.

THE EUREKA ELECTRIC COMPANY have just closed a contract with the Davenport & Tipton Independent Telephone Company, of Tipton, Iowa, for a 480-line express switchboard in four positions, embodying their flashlight transfer and flashlight clearing-out systems; also a chief operator's desk toll line switchboard of 50-line capacity.

EQUIPMENT FOR ARGENTINE REPUBLIC.—The Sindicato de Fabricantes Americanos (Syndicate of American Manufacturers), No. 3 Beaver Street, has secured several substantial orders for electrical equpipment for installation in Buenos Ayres. Mr. George E. Willard, of the Syndicate, is now in that part of the world.

GENERATORS FOR PHILADELPHIA.—It is stated from Philadelphia that the Philadelphia Electric Company has ordered two additional 5,000-hp generators for their Gray's Ferry plant to cost together $240,000.

WESTERN ELECTRIC TELEPHONE SYSTEM FOR MEXICO.—The Western Electric Company has secured the contract for the telephone system to be constructed between Monterey and Torreon, Mexico.

General News.

THE TELEPHONE.

LITTLE ROCK, ARK.—The Lawrence County Telephone Company has been incorporated at Black Rock with a capital stock of $3,000. The officers of the company are F. W. Tucker, president; William De Armen, vice-president; E. J. Mason, secretary; C. H. Martin, treasurer.

WESTERN GROVE, ARK.—The Western Grove Telephone Company has filed articles of incorporation with a capital stock of $25,000, of which $3,000 has been subscribed. The officers are: President, H. R. Magness; vice-president, J. H. Floyd; secretary, C. L. Jones; treasurer, S. R. Crain.

COVINA, CALIF.—The Home Telephone Company operates a 160-drop board and gives service to 150 subscribers. There is expectation of 160 more subscribers from Glendora and other places.

CORA, IDA.—The Cora Independent Telephone Association has rural lines free to stockholders, the charge to others being 25c. There are 50 subscribers and 22 miles of toll line.

PLEASANT PLAINS, ILL.—The Boynton Telephone Company has increased its capital stock from $10,000 to $30,000.

WAVERLY, ILL.—The Waverly Telephone Company operates a 200-drop board, has 220 subscribers and 100 miles of toll line.

STERLING, ILL.—The Prophetstown Exchange of the Interstate Independent Telephone Company is to be rebuilt.

CHINA, ILL.—The Farmers' Telephone Company, incorporated with a capital stock of $2,500. Directors: H. W. Hillson and others.

HOUSTON, ILL.—The Peruvo Progressing Exchange supplies telephone service to 180 subscribers from a 75-drop board. It has 100 miles of toll line.

NUNDA, ILL.—The Union Light & Telephone Company has a 100-drop board and 65 subscribers with prospects of nearly as many more within a year.

RUSHVILLE, ILL.—The Rushville Telephone Company has not yet completed its system, but will probably start with near upon 200 subscribers. It does not own toll lines, but will connect with other companies.

LEE CO., ILL.—The Farmers' Telephone Company has been incorporated with a capital stock of $2,500. The object is to operate a telephone system. Incorporators: Albert N. Crawford, Henry W. Hillson and Christian M. Cross.

RUTLAND, ILL.—The Central Illinois Independent Telephone Company has metallic circuits and has exchanges at Rutland of 200 drops; Wenona, 250; Dana, 150; Long Point, 125 and 125 at another place. There are about 850 subscribers in all and 95 miles of toll line, with more to be built.

CHESTERTON, IND.—The North Western Telephone Company has 100-drop board capacity and 75 subscribers.

SIMS, IND.—The Sims Co-operative Telephone Company has been incorporated with a capital of $7,500. The officers are Chauncey B. Knowlton, president; H. C. Haines, secretary, and Isaac Rust, treasurer.

BOWERS, IND.—The People's Co-operative Telephone Company has 85 subscribers, a 100-drop board and 25 miles of toll line. The subscribers own their telephones and keep their lines in repair, paying 25c. per month for switchboard service and incidental expenses.

CENTRE POINT, IND.—The Centre Point Telephone Company operates a central switchboard, has 74 subscribers and has 50 miles of toll line. This system has connection with all the farmers' lines in the county and with other companies in Clay City and Brazil.

DES MOINES, IA.—The Butler County Telephone Company has been incorporated with a capital stock of $10,000.

ONOWA, IA.—The Manona Telephone Company has been organized with a capital stock of $100,000. Mr. J. W. Huff is one of the promoters.

DES MOINES, IA.—The Gold Field Telephone Company, with a capital stock of $10,000, is of recent organization; among the directors being W. V. Palmer.

COVINGTON, KY.—The Kentucky Telephone Company has been granted a franchise to operate a telephone and telegraph system here.

FRANKFORT, KY.—The Northern Kentucky Telephone & Telegraph Company of Kenton County has been incorporated with a capital stock of $100,000. The incorporators are Frank L. Ludlow, Martin Durrett and Sol. F. Kineon.

LOUISVILLE, KY.—The Independence Telephone Company of Kenton County has been incorporated with a capital stock of $5,000. The incorporators are John M. Chambers, W. T. Loomis, Alvin Perry, C. M. Petty and John L. Vest.

EAST FAIRFIELD, MASS.—The Central Maine Telephone Company has been organized with a capital stock of $10,000. Among the directors is M. D. Holt.

GREAT BARRINGTON, MASS.—The Southern Berkshire Telephone Company has been organized, and the following named officers elected: President, Roscoe C. Taft; treasurer, Clarence E. Culver; clerk, H. Mayhew Whiting. The new company expects to connect Great Barrington by telephone with Alford, Egremont, Sheffield and other places as soon as it receives the proper franchise, and later will extend to the middle West and all the New England States.

HARTLAND, ME.—The Hartland & St. Albans Telephone Company has been incorporated with a capital stock of $10,000. The promoters are Charles A. Moulton, Hartland; C. C. Hanson, St. Albans, and W. H. Farrah, Ripley.

MINAC PRIETAS, SONORA, MEX.—The Yaqui Copper Company has just completed the construction of a new telephone line between this place and Campo Santo Nino.

JACKSON, MICH.—The Citizen's Telephone Company has elected the following named officers: J. E. Richardson, president; Z. C. Edred, secretary and treasurer, and E. B. Fisher, general manager.

PLYMOUTH, MICH.—Connection has been made between the Co-operative Telephone Company and the Livingston Home Telephone Company, at this place, which will give connection with nearly 50,000 telephones in different parts of the state. The Co-operative Company, it is stated, has a switchboard capacity of 12,000 drops, although it has only 100 local subscribers.

ST. JAMES, MINN.—The St. James Telephone Company has been organized. W. M. Barrett is secretary.

NEGORD, MINN.—The Kerkhoven & Hoyes Telephone Company is operated only for local farm service. There are 25 miles of toll line and 50 subscribers.

WILLMAR, MINN.—The Kandiyohi County Telephone Company operates country party lines exclusively, has 225 miles of toll line and 225 subscribers at $1.50 per month.

WINDOM, MINN.—The Southwest Minnesota Telephone Company has a 240 drop board with 192 city subscribers, and 100 farmers. It has 350 miles of toll line and is about to construct more farm lines.

BEMIAJI, MINN.—The Iron Range Electric Telephone Company operates a 300-drop board, has 250 subscribers and 75 miles of toll line, with 40 more to be built. Orders for 50 more telephones have been placed.

PRINCETON, MINN.—The Minnesota Rural Telephone Company operates Stromberg-Carlson and Eureka apparatus; has a 200 drop board and 176 subscribers. It has 42 miles of metallic toll line, and 31 miles grounded.

ALBERT LEA, MINN.—The Albert Lea Telephone Company has a Kellogg switchboard with 150 drops and an Automatic of 1,000-drop capacity, 250 of which are installed. It connects with 13 toll lines entering the city. The demand for farmers' telephones is enormous. There are 400 subscribers.

MANKATO, MINN.—The Mankato Citizens' Telephone Company has a 3,200-drop switchboard, 800 of which are installed. There are 730 subscribers and 125 miles of toll and farmers' lines. Extensions of both the latter are contemplated. This is said to be one of the finest systems in the state and one of the few which has its lines underground.

SARCOPIE, MO.—The Sarcopie Telephone Company has a 50 drop board and 54 subscribers.

MACON, MO.—The Macon Telephone Company has a combination board of 500 drops and 700 subscribers, 200 of whom are farmers.

LUTESVILLE, MO.—The Valley Telephone Company has a 100-drop board, 50 subscribers and 27 miles of toll line with more projected.

LATHROP, MO.—The Clover Leaf Telephone Exchange has a switchboard capacity of 200 drops, 150 subscribers, and 65 miles of toll line.

BROWNING, MO.—The Browning Telephone Exchange is cooperative and subscribers are assessed $3 per quarter. There are nearly 300 subscribers.

RICHMOND, MO.—The Richmond Telephone Company has a 400-drop board, 650 subscribers and 25 miles of toll line. There are more telephones than drops, so farmers' lines have 10 to 15 telephones on one wire.

STURGEON, MO.—The New Century Telephone Company has three switchboards of 100 drops each, which supply service to 418 subscribers. There are 27 miles of toll line, the charge being 25c. to any place on the line.

AUX VASSE, MO.—The Buffum Telephone Company operates a 100 drop board, has 75 subscribers, and 500 miles of toll line. It has doubled its business in four months, and it will be again doubled in the next four months.

NORTH SALEM, MO.—The Browning North Salem & Winigan Telephone Company operates a party-line owned by 25 members, each of whom has one share of stock. The line is free to the shareholders, but a charge of 25c. is made to outsiders.

ARMSTRONG, MO.—The Howard County Telephone Company and Armstrong Exchange uses 70 drops of 100 board capacity, and supplies 160 subscribers. The company has nearly doubled its business in the six months it has been in operation.

JOPLIN, MO.—The Home Telephone Company uses a Sterling 4,000-drop board, 1,500 being installed. There are 1,400 subscribers here and 1,400 at Webb City, Carthage and Carterville. Connection is made with the Kansas City Long Distance telephone system.

MILAN, MO.—The Milan Telephone Company is owned and managed by Mr. J. C. Belshe. It has a 300-drop board, 250 of which are installed, and 250 subscribers. A toll line of 65 miles—the Sullivan County Telephone Company—is included. Improvements are to be made.

ROCKINGHAM, MO.—The Rockingham & Norborne Telephone Company has two central office switchboards and about 225 subscribers—all farmers. There are more than 150 miles of toll line, and the company has a mutual exchange of business, with all adjoining concerns, also with city exchanges.

CARLETON, MONT.—T. A. McClaim is organizing a company to construct a telephone system for the ranchers of the Bitter Root Valley.

OMAHA, NEB.—The Atkinson & Saratoga Telephone Company has been incorporated with a capital stock of $5,000.

TABLE ROCK, NEB.—The Table Rock Telephone Company has a 100-drop board with a 70 drop attachment, 125 subscribers and a few miles of toll line.

FRANKLIN, NEB.—The Franklin Telephone Company operates a 100-drop board with 90 subscribers and 14 miles of toll line. The rate is $1 per month for subscribers and 15c. toll.

PONCA, NEB.—The Ponca Telephone Company has a 100-drop board, 80 city and 25 rural subscribers; 40 miles of toll line. The rates are 50c. per month. Each individual owns his telephone and has a share of stock in the company.

HAY SPRINGS, NEB.—The Hay Springs Telephone Line has steadily increased, but is only run to pay operating expenses. There is a 25 drop board and 44 subscribers, 34 miles of main toll line, and 20 miles branch line. This is a ranch country.

COOK, NEB.—The Home Telephone Company operates a 100-drop board of Eureka make, with 110 subscribers and 24 miles of toll line. Several miles of party lines are projected. The company has a branch exchange at Gray, Neb., and a toll line into Tecumseh.

FLEMINGTON, N. J.—The A. B. Reading Local Telephone Exchange operates a party line 50-drop board, with 106 subscribers. There is a bright outlook in the farming district.

JERSEY CITY, N. J.—The Southern Telephone & Telegraph Company, of Jersey City, N. J., has been incorporated; capital, $25,000. Incorporators: Arthur Johns, E. P. Hervey and George W. I. Dwinell, of Jersey City, N. J.

JERSEY CITY, N. J.—The Atlantic & Pacific Telephone & Telegraph Company, of Jersey City, N. J., has been incorporated; capital, $25,000. Incorporators: Arthur Johns, E. P. Hervey and George W. I. Dwinell, of Jersey City, N. J.

PATERSON, N. J.—The Paterson, Passaic & Suburban Telephone Company has elected the following-named officers: President, Charles W. Kline; first vice-president, George A. Post; second vice-president, W. S. Hancock; treasurer, Barker Gummere; secretary, James W. Lindsay; assistant secretary, F. A. Demarest; counsel, Wayne Dument.

LAS VEGAS, N. M.—The Las Vegas Telephone Company proposes putting in a new switchboard and 6,000 feet of cable. It gives service to 390 subscribers and has a 400-drop board.

BLAND, N. M.—The Bland-Albemarle Telephone line expects to complete many improvements and to double its subscription list soon. It has a 25-drop board, 20 subscribers and 12 miles of toll line.

SARATOGA, N. Y.—At the annual meeting of the Saratoga Telephone & Telegraph Company the following named officers were elected: S. C. Medbery, president; Edward Davis, vice-president; W. Lewis Burk, secretary and treasurer.

ELLENDALE, N. D.—Leiby's Telephone Exchange operates a 100-drop Kellogg board and has 71 subscribers, with more expected in the near future.

BURLINGTON, IA.—The Modern Telephone Company has been incorporated with a capital stock of $300,000.

BUCKLAND, OHIO.—The Buckland Telephone Company is the name of a new company just formed here with H. D. Bowsher as president.

CINCINNATI, OHIO.—The Interstate Telephone Company has been incorporated with a capital stock of $10,000. Directors: F. K. Ludlow and others.

PAYNE, OHIO.—A telephone company has been incorporated here with a capital stock of $20,000. The incorporators are L. C. Polland, W. E. Rose, George Gamroth, H. H. Rose and H. G. Dyarman.

COLUMBUS, OHIO.—The Pultney Telephone Company, of Shady Side, has been incorporated with a capital stock of $1,000 by C. W. Rodefer, John A. Futhey, W. P. Harris, H. B. Wilkinson and C. W. Danford.

CLEVELAND, OHIO.—The United States Telephone Company has completed a long distance toll line into Dayton and Springfield. The exchanges in these towns are about ready to be opened. They will add greatly to the business of the long distance company.

PAINESVILLE, OHIO.—The Painesville Telephone Company has announced an increase in rates. The annual report of the company showed a very satisfactory condition of affairs, but the large increase in the number of subscribers seems to necessitate an increase in rates.

LIMA, OHIO.—A telephone war has broken out at West Cairo between the Bell and the independent interests. The Bell Company attempted to erect a pole line through the village, but the home company forcibly stopped the work. It is claimed the Bell Company has no franchise.

SALEM, OHIO.—The Business Men's Association has issued a letter advising the citizens not to pay the increased rates demanded by the Columbiana County Telephone Company. The association will make a stand against the company in its demand for higher rates for telephone service.

SPRINGFIELD, OHIO.—The Springfield-Xenia Telephone Company has increased its capital stock to $750,000. The company has over 600 subscribers in the towns and 150 among the farmers. The company has exchanges in Xenia, Jamestown, Yellow Springs and Springfield. The Springfield exchange is not yet in operation. L. M. Wolf, of Cleveland, is general manager.

CINCINNATI, OHIO.—The Cincinnati Telephone Company and the Fitzimmons Telephone Manufacturing Company have both applied for franchises in Cincinnati. In reply to an inquiry from the city, the latter company states that it owns 50 miles of wire; has an instrument in all the principal hotels in the city; has contracts with ten independent telephone companies and has four lines to the city corporation limits and connected with independent telephone companies, and that it has a pole line to Madisonville. The company's rates are $72 for business houses and $36 for residence telephones.

BIG SPRINGS, TEX.—The Western Telephone Company, of Big Springs, has been incorporated with a capital of $15,000. The names of the incorporators are C. L. Alderman, R. H. Kemp and Philip Pettit.

SEATTLE, WASH.—The Independent Telephone Company increased its capital from $600,000 to $1,000,000.

BURLINGTON, WIS.—The Burlington, Rochester & Kanesville Telephone Company will increase its capital stock from $2,500 to $5,000.

SCANDINAVIA, WIS.—The Scandinavia Telephone Company has been incorporated with a capital stock of $1,500. Among the directors is Mr. G. C. Wilson.

RACINE, WIS.—It is stated that over 15,000 farmers in this state now receive daily weather reports and weather prognostications by telephone. The reports are transmitted from the headquarters of the weather bureau from the department in this city to the managers of the various rural telephone lines in the state, either directly by telegraph or through long distance lines, and these managers report to their subscribers.

ELECTRIC LIGHT AND POWER.

PHOENIX, ARIZ.—The Fossil Creek Electric Company is constructing on Fossil Creek a plant to harness a 6,000-hp water fall, at a cost of about $1,000,000. The greatest length of power transmission will be 75 miles. The works at the Fossil Creek water falls will consist of two plants, the larger plant involving the construction of five miles of tunnels, ditches and flumes.

ELDORADO, ARK.—The Eldorado Light & Power Company has been chartered. The capital stock is $7,500, all of which has been subscribed for. James H. Stevenson, of Little Rock, is president and the other stockholders are Ector H. Smith, Roy D. Campbell and E. H. Lake.

CORONA, CAL.—The Corona gas and electric light franchises were sold on July 28 to George Brown and M. W. Findley, of the Corona Gas & Electric Company; gas franchise, $150; electric franchise, $250.

LOS ANGELES, CAL.—The Monterey County Gas & Electric Company, with a capital stock of $750,000, has filed articles of incorporation here. The directors are M. V. McQuigg, C. W. Allen, R. C. P. Smith, J. M. Gardiner and Cora E. Hubbell, all of Los Angeles.

LOS ANGELES, CAL.—The Los Angeles Electric Company will light the municipality the coming year—1,219 street lamps at $6.75 per month each.

ALTON, ILL.—The directors of the Alton Railway, Gas & Electric Company and those of the Alton and East Alton Railroad & Power Company have voted to merge the two companies into a new corporation to be known as the Alton Light & Traction Company. The capital stock of the new company will be $1,000,000. The directors elected were J. F. Porter, James Duncan, C. A. Caldwell, O. S. Stowell and George M. Ryrie. The new corporation will have control of the electric street railways in the Altons, as well as the heating, power and lighting plants. The new company will complete the constructions of the new road to East Alton, which was commenced several months ago.

STAUNTON, ILL.—The Staunton & Mount Olive Coal Company is going to put in electric haulage at its plant.

DIVERNON, ILL.—The Madison Coal Co. is putting in two 12-ton electric locomotives at one of its mines at this place.

COLLINSVILLE, ILL.—The Donk Bros. Coal & Coke Company is putting in two 10-ton electric locomotives at its mines.

EAST ST. LOUIS, ILL.—The Interstate Transit Company has announced its acceptance of the power and light franchise as passed by the Council. The company will furnish light and power to the city and to private consumers.

SPRINGFIELD, ILL.—The Springfield Light, Heat & Power Company has been incorporated, with a capital of $100,000. The object is the furnishing of light, heat and power. The incorporators are Emil G. Schmidt, Bluford Wilson and William H. Brown.

PANA, ILL.—The Pana Electric Light Company's plant, franchise, etc., were sold at Master's sale, July 25, to Robert Johns for $45,000. About three years ago Mr. Johns sold the electric plant and telephone exchange to Gregg Rollins and Froelich, of Chicago, for $75,000. Ever since that time the matter has been in the courts.

CHICAGO, ILL.—In the renewal of franchise granted to the Oak Park Yaryan Company by the village board of Oak Park, the company is given the right to increase its charge for heating. In return the company is to light and heat the village hall free, and pay the village $1,000 a year. Hereafter the rate will be by the square foot of radiation instead of cubic foot of space in the buildings heated. The change in rate is said to be an increase of 20 per cent.

WINONA, IND.—The Winona Electric Light & Power Company has been incorporated with a capital stock of $100,000. The directors are Thomas Kane, S. C. Dickey, H. F. Townley and others.

BLUFFTON, IND.—The Bluffton Electric Light Company has been incorporated with a capital stock of $30,000. The company will erect a new plant and supply the city with light and power.

WABASH, IND.—A contract for lighting the streets for ten years has been awarded to the Wabash Electric Light Company. The arc lights are to be increased from 28 to 70 and the number of incandescent lights decreased from 225 to 125. The old contract price was $76 for each arc light, and $18.50 for each incandescent light. The new contract prices are $70 and $17.50 respectively. The company will expend $20,000 in improvements.

ELKHART, IND.—The City Council has passed an ordinance requiring all electric light wires carrying current generated outside the city to be placed in underground conduits on the assumption that the voltage of currents from distances of five miles and more is too great for public safety, if overhead. The ordinance is thought to be aimed at the Elkhart & St. Joe Power Company, a syndicate of non-resident capitalists that is building the immense dam and power house ten miles below the city in the St. Joseph river.

EARLINGTON, KY.—The St. Barnard Coal Mining Company at this place is contemplating changing its power from compressed air to electricity, for the mining and hauling of coal. With this end in view it is building a large brick power house.

AUGUSTA, ME.—The Hoosac Mountain Power Company has been incorporated at Augusta for owning and operating a power plant, capital $500,000, of which nothing is paid in. President, F. L. Dutton; treasurer, E. F. Whittum. Directors: F. L. Dutton, E. F. Whittum, C. L. Andrews, Augusta; H W. Burgett, H. F. Bryant and R. H. Whiting, of Boston.

TURNER'S FALLS, MASS.—The Franklin Electric Light Company has elected the following officers: President, J. F. Bartlett; treasurer, W. C. D. Thomas; clerk, E. I. Cassidy; directors: J. F. Bartlett, C. W. Hazelton, W. D. Russell, Porter Farwell, E. I. Cassidy, C. W. Schuler.

WESTFIELD, MASS.—Work is rapidly progressing on the Buschmann power plant at Still Pond. The dam has been increased in height, much of the work on the dynamo house has been completed and the wires are all strung

ready for connection with the indoor work. It is estimated that with the power available all of the north side of the river could easily be lighted.

TECATITLAN, TALISCO, MEX.—A new electric light plant is to be installed here. It has been exempted from taxation for a period of years.

EL FUERTE, SINALOA, MEX.—It is reported that the company which was granted a concession some time ago for establishing an electric light plant here to cost $50,000 has abandoned the project.

MAPIMI, DURANGO, MEX.—E. S. Glenn, general superintendent of the Penoles Mining Company, says that when the work of installing the engines is completed, that company will have sufficient electrical energy to light the entire premises as well as for doing all the hoisting from the mines and transferring the ore to the smelter.

CITY OF MEXICO, MEX.—It is reported here that the Siemens & Halske Company, which is the principal light and power concern in this city, has sold its property and concession to the Mexican Light & Power Company. The latter company is establishing a great electrical generating plant on the Necaxa River, about sixty miles from this city and has valuable rights under a concession granted it by the Mexican Government.

PUEBLA, MEXICO.—The Mexican Government has granted a concession to Mateo Gonzalez Maroon, or any company which he may organize for the purpose, to establish an electrical generating plant on the Cantarranas River, in the Atlixco district of this state. The concession also grants the right to construct and operate transmission lines. The proposed plant will utilize 200 gallons of water per second. The power is to be transmitted to the cotton mills of that district and to the city of Puebla, a distance of about 35 miles.

OMAHA, NEB.—The Omaha Electric Light & Power Company, recently organized, took over the property of the Thomson-Houston Electric Light Company and the two Council Bluffs lighting companies August 1.

NORFOLK, NEB.—The Norfolk Electric Light & Power Company has $18,000 stock, $10,000 bonds. It has 10 miles of circuit, 60 arc lamps and 3,000 16-cp incandescents. The company intends putting in a water power plant and will need a full outfit, with two 250-kw units.

MILFORD, N. H.—The Milford Electric Light Company has sold its plant to E. M. Prindle, of Providence, R. I., and Charles Bourland, of Boston. The plant is bonded for $50,000.

JACKSON, N. H.—The Wentworth Hall Electric Lighting Company is owned by Mr. M. C. Wentworth and operates 1,000 16-cp incandescent lights. It also does a business in electric cooking apparatus and laundry irons.

TRENTON, N. J.—A certificate of incorporation has been issued by the secretary of state to the Saginaw Bay City Railway & Light Company. The corporation is capitalized for $3,000,000, and is to engage in the manufacture of heat, power and light. The incorporators are Joseph F. Cotter, Wm. F. Eidell and I. C. Clow, all of Camden.

DUNDEE, N. Y.—The Dundee electric light plant operates 3 arc lights of 2,000-cp each, 64 25-cp series street and 2,000 16-cp commercial incandescent lights; also fan motors. This property is for sale.

ALBION, N. Y.—Work has been begun on the transmission line between Albion and Brockport by the Albion Power Company, the company having bought the Brockport electric works at that place some months ago. The Albion company has bought the Clark's mills property at the head of Stillwater, which will be used by the company in its increase of business at the electric plant at Waterport.

JAMESTOWN, N. D.—The Western Electric Company was formed one year ago with $25,000 capital stock. Mrs. J. H. Canham is president. It has now 20 city and 15 commercial arcs, with 4,000 incandescent lights.

ATHENS, OHIO.—The council has passed an ordinance providing for an issue of bonds for building an electric light plant.

COLUMBUS, OHIO.—The municipal plant will have 7 amp. arc lamps instead of 7.5. A further outlay of $2,500 will be put on the new switchboard and the plant will have 27 circuits with 2,400 lights.

INDIANOLA, OHIO.—An ordinance granting the Indianola Heating & Lighting Company a franchise for all the city territory south of the Pan Handle tracks fixes 10 cents net per 1000 watts for lighting and 8 cents per 1000 for power current. It is claimed that the previous ordinance of 1901 was less favorable to the company, providing for a sliding scale and liberal discounts.

SANDUSKY, OHIO.—Directors of the Sandusky Gas & Electric Lighting Company have approved a proposition to issue $100,000 of preferred stock. At the time of the organization of the Lake Shore Electric Railway, this was included in the railway system, but owing to the receivership of the railway company, the property was never paid for, and reverted back to the former stock holders. The company will make important improvements.

MIDDLETOWN, PA.—This town has a municipal plant superintended by Mr. F. P. Stauffer. There are 67 arcs of 2,000-cp and 3,000 incandescent lamps. The capacity of the plant has been increased lately.

WACO, TEX.—A dispatch from Waco says that competent engineers have passed upon the natural dam near Marlin, Falls County, and reported that the water power the dam affords, when converted into electricity, will supply lights and move factory wheels over a wide district with Marlin as a center. In some prehistoric convulsion a great vein of hard stone was set up on edge, the upper edge projecting several feet above the bed of the river and extending far into the valley on both shores. The upper edge forms a terraced dam at Marlin Falls, below which the water rushes in rapids and cascades, giving just the conditions needed for obtaining motor power.

CHARLESTOWN, W. VA.—The Charlestown Light & Power Company, B. D. Gibson, president, has 23 arc lights and 800 incandescents. There is a fine opening for a 1,000-hp water power plant in the vicinity.

THE ELECTRIC RAILWAY.

HOT SPRINGS, ARK.—The Interurban Railway & Power Company desires to interest capital in a scheme it has for developing water power and operating an electric railway and lighting system. The company has secured a 50-year charter in Arkansas, with rights of eminent domain for the lake and a right of way for a car line. The Suachita River is to be dammed four miles from the city limits. W. L. Stebbins gives an estimate of 20,000 horse power at ordinary flow, yet says it is safe to figure on a delivery in the power house of not less than 6,000 horse power at low water. All surveys, maps, etc., have been made.

NORWICH, CONN.—The Norwich Street Railway Company, which recently passed into the hands of new interests, has elected officers as follows: Stillman F. Kelley, of Boston, president; Horatio A. Bigelow, of Norwich, secretary and superintendent; Arthur St. J. Whiting, of Boston, treasurer. The Montville Street Railway Company, controlled by the same interests as the Norwich Company, has elected the same officers.

WILMINGTON, DEL.—The Delaware Suburban Railway Company is preparing plans for its new power house and will require complete equipment for the same. The line will extend from Wilmington to Elkton and surveys are now being made.

MT. VERNON, ILL.—The certificate of incorporation of the Southern Illinois Electric Railway Company has been filed. The company is capitalized at $50,000. The incorporators are John R. Piercy, George F. Ward, Samuel Casey, Louis G. Pavey, Samuel T. Maxey and Albert N. Johnson, of Mt. Vernon.

MUNCIE, IND.—The Union Traction Company is preparing to push its Lima connection, which will give almost a direct line from Indianapolis to Toledo. Surveyors are now at work on the proposed route between Portland and Celina, Ohio, it being the object of the Union Traction Company to tap the big Ohio system of traction lines.

INDEPENDENCE, KAN.—A franchise has been granted by the City Council of this place to A. A. Anderson, of Indianapolis, Ind., to construct and maintain an electric railway through the streets of Independence, and similar franchises have been granted at Cherryvale and Coffeysville. It is the intention to connect these three towns of Montgomery County, and the lines will also extend to Neodesha and Chanute and Iola. Ultimately the line will be extended to Kansas City.

SERGEANT, KY.—The Wise County Electric Light, Power & Transportation Company has been organized at Norton, Va. The corporation will build an electric railway connecting practically all of the Wise County mines.

HAGERSTOWN, MD.—The Hagerstown Street Railway Company will extend its system from Boonsboro to Myersville to connect with the Frederick road. It is stated that the link will cost $10,000 a mile, or in all, about $50,000.

AMITYVILLE, N. Y.—The Village Trustees have granted the South Shore Traction Company a franchise to build an electric railway through this village.

ITHACA, N. Y.—The Ithaca & Auburn Electric Railway Company, of Ithaca, has been incorporated to construct a forty-mile railroad from Auburn to Ithaca. Its capital is $1,000,000. The directors are Sherman Collins, Ithaca; Isaac P. Hazard, Dexter Wheeler, Poplar Ridge, Cayuga County.

TUXEDO, N. Y.—There is a project on foot for a trolley line from Tuxedo to West Point and Highland Falls. It is not expected that the line would be a money maker, as it would be practically a private line for residents of Tuxedo Park. The country through which it would pass is most picturesque and would be enjoyed by residents of the park.

CHARLOTTE, N. C.—A big concern, with $10,000,000 capital, is being organized in Virginia to be known as the Cumberland Transportation, Light and Power Company. The proposed railway line will be 25 miles in length. The power plant will be located at Morton. The company will also furnish light and power to a number of towns. Henry M. Smyth, of Wise County, is the chief promoter.

AKRON, OHIO.—Thomas L. Childs, the promoter of the Cleveland, Akron & Southern Fast Line, has secured a franchise in Summit County for the extension of the projected road from Akron to Massillon.

PAINESVILLE, OHIO.—The Cleveland, Painesville & Ashtabula Railroad Company, of Cleveland, have completed plans for a carhouse and repair shops for their electric road. The building will be erected at Painesville, Ohio, adjoining the power house, now under erection.

CINCINNATI, OHIO.—The Beulah Construction & Realty Company has been organized to build electric and steam roads in Colorado. M. Izer, of Cincinnati, is president; W. A. Beatty, of St. Louis, vice-president and general manager; J. E. Rize, of Pueblo, Col., secretary and treasurer.

COLUMBUS, OHIO.—Franklin County Commissioners have granted a franchise through the county to the Columbus, Marysville & Bellefontaine Railway Company, which is promoted by William Luchtenburg, L. K. Guthke and M. B. Earnhart. It will form a part of the through line from Columbus to Toledo.

COLUMBUS, OHIO.—The Scioto Valley Traction Company has awarded the contract for the construction of its power house. The building will be located at Reese's Corners, five miles south of Columbus. The contract for the electrical equipment for the house was placed some time ago with the Bullock Electric Company, of Cincinnati, Ohio. The company will soon close a contract for the erection of a car house, which will be located near the power house.

DELAWARE, OHIO.—Officials of the Mansfield, Mt. Gilead & Delaware Electric Railway claim that arrangements have been completed for financing the project. The right of way has been obtained and contracts for the construction of the portion between Mansfield and Mt. Gilead will be closed at once. W. W. Stark and C. E. Fritzinger, of Mansfield, are the chief promoters. The line will connect Delaware with the Columbus, Delaware &

Marion Railway, and will form part of the through route from Cleveland to Columbus.

HARRISBURG, PA.—It is stated that the Central Pennsylvania Traction Company will expend $1,000,000 on a new power house and enlargement of its system and equipment.

JOHNSTOWN, PA.—The Johnstown & Geistown Electric Railway Company has purchased a site at Jacob's Hollow for a power house. Right of way for the line between Johnstown and Geistown has been secured from Walnut Grove to Geistown.

HARRISBURG, PA.—Charters have been granted at the State Department to the East Butler Street Railway Company, capital $6,000, to build a one mile line; D. H. Sutton, president; J. F. Anderson, I. H. Teputman, J. S. Campbell, G. H. Murphy, W. D. Brandon, directors; Danville & Riverside Street Railway Company, capital $18,000, to build a three-mile line from Danville to Riverside via South Danville; W. F. Pascoe, of Allentown, is president.

HOUSTON, TEX.—The Houston Electric Street Railway Company has ordered additional boilers, generators and engines that will more than double the capacity of its plant on Commerce and Austin and La Branch streets. The building will also be enlarged. In addition to this betterment, the company expects to extend its system to Harrisburg.

NEWPORT NEWS, VA.—At a meeting of the Citizen's Railway & Electric Company the following named officers were elected for the next year: W. A. Post, president; W. J. Payne, vice-president; H. H. Dalton, secretary; W. J. Naw, treasurer; Charles M. Franklin, assistant treasurer.

MORGANTOWN, W. VA.—A new company has just been chartered here to operate an electric railway between Morgantown and Terra Alta. It is capitalized at $25,000, all of which is subscribed. The new company has bought out the plant which has supplied electric light to Terra Alta and will enlarge it. The incorporators are J. Ami Martin, manager of the M. & K. Railroad; W. E. Arnett, of the Second National Bank; W. J. Snee, W. H. Mahcroft and Frank Weaver.

SPOKANE, WASH.—Plans are about completed for what will be one of the longest electric railways in Eastern Washington. Calvin Lunceford, president of the Adams County Electric Transit Company, states that a company was organized a few weeks ago for the purpose of developing water power at Palouse Falls and constructing an electric railway from Washtuena north through Ritzville to some point on the Great Northern Railroad. The statement is given out that the road will go through Ritzville, Mohler, Harrington, Davenport, Medical Lake and into Spokane. The company will be ready to let contracts for building the dam at Palouse Falls in a few days. It is expected to develop 5,100-hp at low water. The electric railway will be about 140 miles long and is expected to cost about $8,000 per mile. It will tap 14,000 sections of the finest wheat land in the world, and it is expected the road will be ready to move the 1904 crop.

NEW INDUSTRIAL COMPANIES.

THE EXPANSION PLATE STORAGE BATTERY COMPANY has been incorporated at Camden, N. J., with a capital of $100,000.

THE MARTIN ELECTRIC COMPANY, of New York, has been incorporated with a capital of $15,000. Directors: Alexander Martin, G. L. Martin and F. D. Haines, New York.

THE ELECTRICAL & HOUSEHOLD MFG COMPANY has been incorporated at Newark, N. J.; capital, $100,000. Incorporators: Franklin Mortimer, Nellie Mortimer, Gardner W. Kimball.

THE RAPID TRANSIT AUTOMOBILE COMPANY, of Buffalo, has been incorporated with a captial stock of $10,000. The directors are Charles W. Roe, John M. Campbell and Arthur S. Hartsell.

THE HAVANA ELECTRICITY COMPANY, LIMITED, of London, has been formed to develop railways, lights, telephones, telegraphs and other electrical industries in Cuba. The capital stock is $1,500,000.

THE INDUSTRIAL STORAGE BATTERY COMPANY has been incorporated at Camden, N. J., with a capital stock of $500,000. The incorporators are Joseph L. Stickney, Charles F. Guyon and G. H. Lang.

ORISKANY VALLEY ELECTRIC COMPANY, of Utica, has been incorporated with a capital of $100,000. Directors: G. I. Hovey, of Deansborough; J. F. McBride, of Clinton, and W. C. McAdam, of Utica.

THE NOLL ELECTRIC COMPANY has been organized in New York City to take over the business of Augustus Noll, electrical contractor. The officers are Augustus Noll, president; O. C. Braun, vice-president and treasurer, Chas. A. Noll, secretary.

THE ALLOWAY ELECTRIC COMPANY, of Chicago, has been incorporated, capital $2,500, for the purpose of manufacturing machinery, electrical apparatus and supplies. Incorporators: Wilmore Alloway, Harry Alloway and Edward McMahon.

THE GREENWOOD AND DAGGETT COMPANY has been organized at Portland, Me., for the purpose of manufacturing and dealing in electrical goods. The capital stock is $50,000. The officers are: President, William H. Green; treasurer, Percy L. Andrews.

HOLMES ELECTRIC COMPANY.—The Holmes Electric Company was incorporated at Baltimore, Md., last week by Gwyllyn R. Holmes, William H. Rose, Florence W. Holmes, Thomas Sudler and J. Cecil Knouss. The company will have a capital stock of $10,000 and will engage in manufacturing and dealing in electrical apparatus, etc.

THE TELEGRATYPE COMPANY has been registered at Augusta, Me., for the making and sale of electric apparatus. Capital, $300,000, of which nothing is paid in. President, I. L. Fairbanks; treasurer, J. Williamson. Directors: I. L. Fairbanks and J. Williamson, of Augusta; Paul Petukin and Joy Morton, of Chicago, Ill., and J. Berry, of Augusta.

LEGAL.

INJURY BY LIVE WIRE.—In affirming large damages recently in a case of injury from contact with a live wire, the supreme court of Illinois held that it was permissible in such a suit to present the clothing worn at the time by the plaintiff, as tending to illustrate the manner in which the injury was occasioned.

MUNICIPAL TELEPHONES.—A suit has been brought against Evansville, Ind., for an injunction to prevent it from taking stock in a municipal telephone system or from exercising any rights as a stockholder under the attempted subscription already made. The city can hold such stock under its charter, but it is contended that this is different from being chief organizer of an experimental company; besides which the city would be liable finally for all the indebtedness of the company should it fail, as it probably would do.

MOTOR STARTER LITIGATION.—H. Ward Leonard, who owns a large number of patents claimed to cover the features of what is generally known as the Navy type motor starter, has instituted suit against several manufacturers for the alleged infringement of eight of his patents in the Navy type starter as made and sold by them. Mr. Leonard claims that his patents cover all commercial forms of starters having any voltage release in combination with an independent magnetic overload circuit breaker. Also that his patents cover what is known as the enclosed type starter in which the resistance wire or ribbon is enclosed in an insulating and heat absorbing material, such as sand, contained in an iron box.

EDISON-LALANDE BATTERY SUIT.—An action against Thomas A. Edison for alleged infringements of patent rights on a galvanic battery has been brought in the United States Circuit Court at Trenton, N. J., by James W. Gladstone, of West Orange. This suit follows one filed by the Edison Manufacturing Company against Gladstone and others for a similar infringement. The two suits concern Edison's claimed improvements on the battery. Gladstone declares that the improvements were first patented by Felix De Lalande, of Paris, who sold his rights to William M. Offley, of Washington, who transferred his interests to Gladstone. The court is asked to compel the defendant to make an accounting of the profits made from the improvement, and turn them over to the plaintiff.

TELEPHONE RIGHT OF WAY.—In the appeal to the Supreme Court of Nebraska, of the suit of the Nebraska Telephone Co. vs. the Western Independent Long Distance Telephone Co., the syllabus of the decision by the court, Judge Albert presiding, was that: 1. The term "public roads," in section 14, c. 89a, Comp. St. 1901, giving telegraph and telephone companies a right of way along the public roads of the state, does not include the streets and alleys of a municipal corporation, and the unauthorized use of such thoroughfares for such purpose constitutes a public nuisance. 2. A court of equity will not lend its aid to protect a suitor in maintaining a public nuisance, nor in the doing of an act punishable under the laws of the state. The suit arose out of the effort of the Bell system to restrain the independent competitors in erecting pole lines with wires above and through the old wires in the village of Louisville, Neb. The decision affirmed the lower court's finding for the defendants.

TELEPHONE DIRECTORY.—An impatient subscriber who wanted a new directory issued the moment he had his telephone in, at Seattle, Wash., got a mandamus against the Sunset Telephone Company to compel it to issue its directory forthwith, on the ground that he was sustaining injury. The supreme court of Washington State made short work of the business and reversed the order. It was held: 1. Where a writ of mandamus was issued against a telephone company to compel it to issue a directory of its subscribers, and distribute the same "on or about April 15, 1902," from which defendant appealed and filed both supersedeas and appeal bonds, the fact that before the hearing of the cause on appeal an affidavit was filed showing that on the 15th day of April, 1902, defendant did distribute a telephone directory among its subscribers, which was published in the ordinary course of its business, without intending to comply with the order of the court, did not require a dismissal of the appeal on the ground that no controversy between the parties remained. 2. Where plaintiff applied for a writ of mandamus against a telephone company to compel it to issue a directory of its subscribers and the company, in its answer, asserted that it was about to issue a directory, which would be printed and distributed early in the month of April, 1902, it was error for the court, on such admission, to direct the issuance of a peremptory writ requiring the issuance of such directory on or before April 15, 1902, no writ being necessary, under such admission, to obtain the relief demanded.

WATER POWER AT SALT LAKE.—In a dispute with the city over the right of the Salt Lake Water & Electrical Power Company to use water and discharge it again from its plant into the city canal, the supreme court has strongly upheld the company. One passage of a decision on the subject is as follows: As said in the former opinion of the majority of this court, this is a case where the two uses can stand together without injury to the prior appropriator, and where there is no injury equity will refuse a recovery. That the decree herein is just, under the circumstances, and ought to stand, is emphasized by the fact that, of the very numerous parties, prior appropriators of water from the same stream, to this action, the city is the only one to complain, or to express any alarm because of the decision. That, for its own welfare—for its material advancement and that of the state—the city ought to encourage rather than discourage the location of industrial enterprises like the one in question it would seem there can be no doubt. The undertaking is in harmony with the progressive spirit of the times. Neither the establishment of the plant nor its operation violates any law. It utilizes electric energy which is destined to revolutionize the various methods of promoting power and propelling machinery. In its operation the water used is neither impaired in quality nor diminished in quantity, and the city, having, at the begnning of the operation of the plant permitted and sanctioned the use of the water, ought not now be heard to complain without showing resulting injury.

INSPECTION OF LIGHTING.—In affirming a decision for plaintiffs in a case of fatal injury due to shock, and in overruling exceptions, the Supreme

Judicial Court of Massachusetts says: "Whether the jury should have been instructed that there was no evidence of negligence on the part of the corporation itself turns upon the question whether the system of inspection was all that due care required of it under the circumstances. Under it no one had a duty of making a thorough examination, even by the eye, of the lamp and its connections, oftener than once in nine days, and all such examinations were made in connection with the manual work of cleaning globes and renewing carbons. The visits twice each night of the inspectors who drove past showed simply that the lamp was in working order at that time, and had no tendency toward ascertaining the presence of circumstances which might then be present and which at any moment might make the apparatus dangerous. Electric wires exposed in the open air to the action of the elements, and all the apparatus of the pole and lamp as they grow older, have an increasing tendency to become defective, while the destructive agency which they carry remains active. Under such a condition of things, the care which a corporation having a lighting plant extended throughout a city should exercise in the oversight of its apparatus, with a view promptly to discover defects giving rise to the greatest danger, is one which is peculiarly proper for the determination of a jury of the vicinage. In our opinion it was proper in this instance to submit it to the jury, and certainly, in our view, it would have been wrong to rule as matter of law that there was no evidence of negligence in this respect on the part of the defendant itself."

PERSONAL.

MR. A. S. COLLETTE, of J. G. White & Company, 29 Broadway, New York, has returned from a two-months' trip to Europe. He visited England, Holland, Germany, France and Switzerland.

MR. H. E. RICHARDS.—Among New York's summer visitors recently was H. E. Richards, advertising manager of the T. Bissell Company, of Toledo. Mr. and Mrs. Richards are making a little tour of the east before returning home.

MR. ALFRED WISEMAN, M. I. M. E., promoter of the Electric Tramway Equipment Company, of Birmingham, England, is on a short visit to the United States, for the benefit of his health. He has many friends in this country.

MR. H. H. VREELAND, president of the Metropolitan and Interurban Street Railway systems of New York City, who has been traveling in Europe and giving valuable testimony in England as to the handling of large passenger traffic returned home last week.

MR. HARRY T. EDGAR, vice-president and manager of the El Paso Electric Railway Company and the International Light & Power Company, has been making a trip north and taking a little vacation while attending to matters connected with the system under his charge.

DR. ROBERT DAHLANDER is on a visit to the United States on behalf of the Swedish State Railway Department, and will report on American electric railway practice. The Swedish government is seriously considering the change of its railroads from steam to electric power.

MR. C. P. STEINMETZ, chief engineer of the General Electric Company is named in the new faculty of Union College as head of the department of mechanical and electrical engineering. Few equal Mr. Steinmetz in his luminous exposition and swift insight into the real essentials of a problem or topic.

MR. W. DRUMMOND MARROW, electrical engineer, of Charlotte, N. C. has been selected by the Board of Commissioners of Laurinburg, N. C., as their consulting and supervising engineer to prepare plans and specifications for their electric light system and to install their electric light plant. This plant will cost $10,000.

MR. G. C. FRENCH.—The Iowa Falls Electric Light & Power Company has just elected a new superintendent in the person of Mr. G. C. French, of Chicago. Mr. French succeeds F. B. Curtis, who has been superintendent of the plant for the past seven years, who resigns to engage in business for himself at his old home in Chariton, Iowa.

MR. MORTIMER NORDEN, of the Norden-Bittner Electric Company, has just designed a new marine incandescent lamp with two filaments, each of which can be automatically cut in, in case the other burns out. The idea was suggested to him by Miss Colwell, who, it is said, will in the near future take out patents on several electrical devices.

DR. WILHELM OSTWALD, the distinguished German electrochemist, will arrive at New York next Tuesday on a visit to this country of some weeks, and will be present at the inauguration of a course in electrochemistry at the Leland Standford University. Dr. Ostwald will bring with him for introduction in this country a new photographic process which he has developed.

MR. H. F. TATE.—The many friends and business acquaintances of Mr. H. F. Tate, the Western manager of the National Conduit & Cable Company, will sympathize with him because of his recent bereavement in the loss of his daughter Beatrice, who was killed by a train at Williamsport, Pa., on July 29. Mr. Tate's daughter, who was only 12 years old, was in the East spending her vacation at his old home. The body was taken to Chicago for interment.

LIEUT. GODFREY L. CARDEN, R. C. S., who has been in Europe as the representative of the Department of Machinery of the St. Louis Exposition, met with much success there, particularly in Germany and Belgium, in securing operating exhibits. Many of the great European steam and gas engine builders will be represented at the Fair, and their exhibits of the latter machines of large power promise to form one of the striking features of the Exposition.

MR. J. L. HUDSON, of Detroit, one of the leading merchants of the country and famous for his advertising, having looked into the merits of the Thos. E. Clark Wireless Telegraph Company's apparatus, has adopted it for commercial use in his store, having installed two stations. This novel and scientific feature is a success. Orders and messages are being sent from station to station constantly. This not only affords a study to the electrical student, but also proves very entertaining to the many hundreds of customers who visit the Hudson establishment.

MR. LEWELLYN PREECE and MR. FRANK Z. MAGUIRE, both of London and interested in electric railway matters, arrived on the *Lucania* Saturday to make a trip of observation. Mr. Preece is a son of Sir Wm. H. Preece, consulting engineer for the British Postal telegraph service. On arrival here, Mr. Preece found a cable announcing the dangerous illness of his father, who had been suddenly taken with pneumonia, and asking his immediate return. He therefore took the first returning steamer, the *Pretoria,* of the Hamburg-American line and was on his return trip two hours after arrival. He had never crossed to America before. Sir Wm. Preece occupies a very prominent position in the electrical profession, and his loss would be seriously felt.

MR. WILLIAM PASTELL has resigned his position as superintendent of motive power of the Worcester Consolidated Street Railway Company and will join the railway engineering staff of the J. G. White Company. Mr. Pastell is one of the best known electric railway engineers in New England, and possesses wide experience in this field of engineering. He was assistant engineer to the Lynn & Boston Railroad from 1893 until 1899, when he became its chief engineer. He held this position until May, 1901, when he resigned to take the one he is just leaving in Worcester. During his two years in Worcester, Mr. Pastell has effected marked improvement in the physical condition of this railway property. Mr. Pastell is also an authority on the subject of signals for electric railways.

MR. T. A. EDISON is quoted by the *Wall Street Journal,* as follows, in regard to the Marconi system: "There is absolutely no reason why Marconi may not develop a speed of 500 words a minute in the transmission of trans-Atlantic messages. On the other hand, there are technical scientific and mechanical obstacles which make it absolutely impossible to increase the speed of transmission by ocean cables. There is absolutely no doubt but that the Marconi system is successful. All this talk about lack of secrecy, interruption and the interception of messages, is nonsense. What secrecy is there in cable operation? At least ten men know the contents of every cable message, and none of them receives a very high salary. No business man ever entrusts an important business secret to the wires without employing a cypher code. There is no doubt but that code will be necessary in the wireless system just as it is in the cable system. Personally, I have no doubt but that the Marconi system is both a commercial and a scientific success. I have agreed to act as a member of the company's technical board and expect to consult with Mr. Marconi when he returns to this country."

MR. A. C. DINKEY.—As a result of the recent and important changes in the personnel of the United States Steel Corporation, it is understood that Mr. A. C. Dinkey will become president of the Carnegie Steel Company. He is only 37 years old. He was a telegrapher on the Baltimore & Ohio Railroad at Braddock at the age of 16, and later at the Edgar Thomson Steel Works. He then became a machinist at Pittsburg Locomotive Works for three years. He became associated with Thomas McTighe, Mr. McConnell and others in introducing electric lighting in Pittsburgh. He then went to the Homestead Steel Works and took charge of the electrical department. He was first to introduce electricity for driving feed tables and revolutionized rolling mill practice, displacing hooks and tongs operated by hand labor. Four men were only required at rolls instead of 25. He effected a great reduction in labor cost. The practice is followed all over the world. He was also one of the first to introduce electric cranes in rolling mills. He assisted in the development of the electric charging machine and has patented one type. He is also the inventor of the Dinkey controller in general use in steel works and rolling mills and a crane for soaking pits. In 1898 he was appointed assistant general superintendent of the Homestead Works, and succeeded William E. Corey as general superintendent in April, 1901. His career is one of the most striking in the steel industry.

EDUCATIONAL.

MASS. INSTITUTE OF TECHNOLOGY.—Prof. H. E. Clifford, of the electrical engineering department of the Mass. Institute of Technology, reports the following graduates this year in electrical engineering, with the positions taken: F. Z. Brown, Consulting Electrical Engineer, Richmond, Va.; J. H. Brown, Bar Harbor Electric Light & Power Co., Maine; H. C. Burdick, on a ranch in the West; G. H. Clark, Stone Telegraph & Telephone Co., Boston; R. W. Eaton, Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; W. O. Eddy, General Electric Co., Schenectady, N. Y.; A. L. Fischer, Manager, The Standard Electric Time Co., Boston; S. H. Fletcher, General Electric Co., Schenectady, N. Y.; E. D. Forbes, Assistant in Physics Mass. Institute of Technology; J. M. Gammons, Assistant in Electrical Measurements, Mass. Institute of Technology; G. H. Garcelon, Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; C. F. Gardner, Boston & Northern Street Railway, Boston; C. S. Glenn, General Electric Co., Schenectady, N. Y.; L. R. B. Gould, New England Telephone & Telegraph Co.; J. L. Jones, N. Y. & N. J. Telephone Co.; J. A. Mears, Consolidated Car Heating Co., Albany, N. Y.; W. E. Mitchell, General Electric Co., Schenectady, N. Y.; F. P. Montgomery, Indiana Traction Co.; H. M. Morley, Graduate student in electrical engineering, Mass. Inst. of Technology; H. G. Nutter, Crest Mfg. Co., Cambridge, Mass.; G. B. Obear, instructor in electrical engineering, Lowell Textile School, Lowell, Mass.; H. Osborn, assistant in electrical testing, Mass. Inst. of Technology; A. W. Pearson, N. Y. & N. J. Telephone Co.; C. H. Porter, with Stone & Webster, Boston, Mass.; A. A. Potter, General Electric Co., Schenectady, N. Y.; P. B. Rice, N. Y. Telephone Co., N. Y. City; F. T. Taylor, General Electric Co., Lynn, Mass.; J. W. Welsh, U. S. Steel Corporation; D. S. Wilson, Associated Mutual Fire Insurance Companies, Boston. In addition to these, the other graduates whose assignments are not known were J. A. H. Colgate, F. B. Crosby, J. J. Dooley, K. W. Endres, M. Ferry, D. H. Fisher, W. M. Gilker, R. J. MacGregor, F. C. Reed, D. A. Smith.

Trade Notes.

WALLACE BARNES COMPANY, Bristol, Conn., have in the hands of the printer a more elaborate catalogue than they have ever yet issued as to their specialties in small springs, wire and cold rolled steel.

SWEDISH-AMERICAN TELEPHONE COMPANY.—Mr. E. B. Overshiner, president of the Swedish-American Telephone Company, who recently visited New York City, in an interview, stated that their business shows a marked increase during the summer months over last year and they find it necessary to run a night force in order to keep up with their orders.

THE WATERTOWN ENGINE COMPANY have recently opened a Chicago office at 27 North Canal St., in charge of the W. P. Lyons Company. Mr. Lyons is an engine man of long experience, perfectly familiar with the work of erecting and installing as well as of selling. He will be glad to respond promptly to any inquiries.

AUTOMOBILE INSURANCE.—Wilson R. Smith, 11 Produce Exchange Building, New York, is offering an automobile liability policy which insures an automobile against loss by fire wherever the machine may be, whether stored in any building, or while in transit by railroads or ferries anywhere in the United States. A form of insurance against accidents in automobiles is also offered.

SMALL RESISTANCE UNITS.—With this title the International Instrument Company, 23 Church St., Cambridge, Mass., has issued a pamphlet descriptive of flat and tube enameled resistance units for rheostats, controllers, dimmers and other uses where it is desired to have resistance in compact, indestructible form. As indicated by the designation, the resistances are in standard units which can be assembled in any number required for a given case.

TELEPHONINE.—The Telephonine Company of America, New York, has issued a small pamphlet setting forth the merits of an antiseptic telephone attachment. This mouthpiece attachment does not interfere whatever with the transmission of sound. About once in 15 to 30 days 20 drops of "telephonine" is put on the center of the pad in the mouthpiece, which gradually condenses from the pad on to the rim and inner surface of the mouthpiece and renders all germs innocuous.

CIRCULAR LOOM CONDUIT.—A twelve-page pamphlet recently issued by Thomas G. Greer, Chicago, is divided between advice to young men and enumeration of one hundred and one places where Circular Loom is used. Mr. Greer's advice to young men is equally applicable to men of any age who wish to succeed in life; and the indication of where an insulation such as that supplied by a Circular Loom is applicable will be of much instruction to those engaged in electrical installation.

SPARK COILS.—The Electric Contract Company, 53 Maiden Lane, New York, is making a coil known as the Williams Spark Coil, which is particularly adapted for gas and gasoline engine ignition. No paper or paraffine is used, the coils are wound in sections and the vibrator spring is on a rocker that is always clamped in position, there being no screw through the spring. Platino-iridium contact points are used. The same firm has issued a catalogue of the "Light of Asia" portable electric lamp.

THE LE VALLEY-VITA CARBON BRUSH COMPANY, in a circular, notifies its customers of the extraordinary operations of a former employee. It appears that this employee, under the name of the Excelsior Electric Company, solicited orders from many of the Le Valley-Vita customers, claiming to have been appointed sole agents for the sale of their carbon brush, which they offered at a reduced price. Orders received on such solicitation were filled, it is stated, with brushes stolen from the factory, which accounted for the price at which they were offered.

PEERLESS RUBBER MFG. COMPANY, 16 Warren Street, New York City, has just issued a very neat and handy pamphlet as to its Rainbow packing and other specialties, such as Dale's, Hercules, Honest John, Success, Arctic, etc.; as well as its other specialties in the line of sheet, square, round, etc., gauge glass rings, gaskets, rubber belting, valves, tubing, hose, mats and matting. This progressive concern sold no less than 1,526 tons of Rainbow packing last year, and some cogent reasons are given for this marvelous trade record. The pamphlet is its Engineers' Specialties Catalogue No. 58, and can be had by anyone on application.

THE "ELECTROTHERM."—The H. W. Johns-Manville Company, New York, has just issued a card containing on one side a large colored illustration of an "electrotherm," and on the other a view of an old-fashioned hot water bag. On each side is a cover divided in two down the center, the two halves opening like a double door. The advantages of the electrotherm are pointed out on the cover on the electrotherm side of the card, and the disadvantages of the hot water bag are enumerated on the cover of the other side. On each cover is a half-tone illustration of a thermometer intended to show the degrees of heat that can be maintained by each method of applying heat in the treatment of disease.

INTERNATIONAL INSTRUMENT COMPANY, 23 Church St., Cambridge, Mass., has been incorporated under the laws of Massachusetts, and will construct high-grade scientific laboratory and engineering apparatus. It will also offer the services of skilled mechanicians and the facilities of good equipment for the construction of new and improved forms of apparatus, and manufacture and sell the same, and will undertake the execution of fully designed physical, astronomical, psychological, electrochemical and meterological apparatus, as well as the development and perfection of partially designed apparatus. The company will also manufacture certain forms of its own development and procure for customers promptly and sell to them at makers' prices anything wanted in the line of laboratory supplies, either domestic or foreign.

"G. I." CHANGE OF ADDRESS.—In a circular to the trade, Mr. Martin J. Insull, second vice-president, says: On and after August 10, 1903, the address of the general sales offices of this company will be 529 West 34th Street, New York. This removal has been occasioned by the purchase of our present building by the Pennsylvania Railroad Company (for its metropolitan tunnel work), but the G. I. Company has taken advantage of the opportunity thus afforded to supply its own need of more facilities for all of its departments, due to the great and rapid increase of its business during the past few years. While thanking you for past favors, we are therefore also pleased to be able to advise you that with an enlarged manufacturing plant and generally increased and improved facilities in all departments, the G. I. Company will be able, when settled in its new quarters, to furnish a more varied line of goods, effect quicker deliveries, and in short to serve its customers better than ever.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 4, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,141 (Re-issue). APPARATUS FOR SELECTIVE ELECTRIC SIGNALING; J. S. Stone, Cambridge, Mass. App. filed July 11, 1903. A resonant circuit including a condenser having one fixed armature and one movable armature, together with means for indicating the movement of the latter.

735,052. ELECTRIC MOTOR; N. C. Bassett, Boston, Mass. App. filed Dec. 5, 1900. The counter shaft with its spur gear can be angularly shifted to any one of several positions around the frame of the motor to adapt the latter for use in various situations.

735,077. STARTING-SWITCH FOR ELECTRIC MOTORS; Augustine R. Everest, Lynn, Mass. App. filed May 22, 1902. The switch has "starting" and "running" positions, and at the proper time will automatically pass from the former to the latter.

735,083. SWITCH OPERATING DEVICE; G. E. Fry, Allegheny, Pa. App. filed Aug. 28, 1902. A railway switch in which an electro magnet is used to set a lever in position to be actuated by the car wheel for throwing the switch.

735,103. CONSTANT CURRENT TRANSFORMER; D. O. Hull, St. Louis, Mo. App. filed Jan. 15, 1902. A two-part core for the primary and secondary coils, one of which is rotatable and adapted by its movement to shunt the magnet flux of the primary coil through the core around the secondary coil in harmony with the variations of current in the latter coil.

735,118. POLYPHASE ALTERNATING-CURRENT INDUCTION MOTOR; Walter Langdon-Davies and Alfred Soames, Surrey, England. App. filed June 9, 1902. The secondary core is so constructed as to offer a path of high resistance to Foucault currents, and the secondary winding is of high conductivity.

735,151. CENTRIFUGAL STARTING SWITCH FOR INDUCTION MOTORS; Henry G. Reist, Schenectady, N. Y. App. filed May 26, 1902. A plurality of independent switches are mounted on the secondary and independently actuated at different times by centrifugal force, thus gradually cutting out starting resistance.

735,160. ELECTRIC MOTOR; T. A. Seitz, Grand Rapids, Mich. App. filed March 23, 1903. The motor is mounted on a universal joint so that its shaft may be thrown into any position convenient for such operations as carving and engraving.

735,161. ELECTRIC ARC LAMP. C. Senez, Paris, France. App. filed Aug. 9, 1901. Details of a differential lamp.

735,168. ELECTRICAL MEASURING INSTRUMENT; J. F. Stevens, Philadelphia, Pa. App. filed Nov. 17, 1900. A mounting for the various parts whereby the moving system may be removed and replaced without changing a constant of the instrument.

735,170. ELECTRO MAGNETIC SWITCH FOR ELECTRIC RAILWAYS; S. B. Stewart, Jr., Schenectady, N. Y. App. filed May 1, 1901. An arrangement whereby the magnetization can be maintained and the switch held in the position to which it has been moved by the magnet with a less current than that required to effectively energize the magnet with a maximum air-gap.

735,171. SYSTEM OF ELECTRICAL DISTRIBUTION; S. B. Stewart, Jr., Schenectady, N. Y. App. filed May 31, 1902. The invention has for its main object to simplify the operation of connecting the actuating coil of the electro magnetic switch to the auxiliary source of power and the main source of power respectively, and of connecting the auxiliary source of power to the main source in order to recharge the former from the latter.

735,182. ELECTRIC HEATING APPARATUS; D. M. Watson, Portland, Ore. App. filed Aug. 19, 1902. A receptacle consisting of a wire framework having a flexible covering and with one end open through which to insert an electric lamp to be utilized as a heater.

735,188. LAMP SOCKET; H. C. Wirt, Schenectady, N. Y. App. filed April 30, 1900. Details.

735,189. CEILING BOARD HANGER FOR ARC LAMPS; H. C. Wirt, Schenectady, N. Y. App. filed June 19, 1901. The board is provided with a spring supported hook for the lamp and for a lamp controlling switch.

735,190. CONTROLLING INDUCTION MOTORS; Arnaldo P. Zani, Berlin, Germany. App. filed Aug. 11, 1899. The secondary has two alternator paths, one of high resistance and low inductance, and the other of low resistance and high inductance. At starting the secondary current owing to its high frequency will flow through the former, and at speed through the low resistance of the latter.

735,210. ENGINE STOP; J. H. Cary, Providence, R. I. App. filed May 18, 1903. An electro magnetic tripping mechanism actuating the throttle valve.

735,212. INSULATOR; V. G. Converse, Pittsburg, Pa. App. filed Nov. 10, 1902. Details of a petticoat insulator.

735,237. TROLLEY WHEEL; R. & R. W. Fox, Parkersburg, W. Va. App. filed May 20, 1903. The axle or pin of the wheel is carried by blocks

having free movement in curved guides to permit the blocks to move independently when the wheel strikes an irregular portion of the wire.

735,249. ELECTRIC SWITCH; G. Hail, Providence, R. I. App. filed Oct. 31, 1902. Details.

735,250. ELECTRIC RAILWAY SYSTEM; G. T. Hanchett, Hackensack, N. J. App. filed July 18, 1902. A means for transforming energy comprising a dynamo, a fluid pressure mechanism for driving the dynamo, a device governed by the fluid pressure to cause the dynamo to act as a motor to furnish energy to restore the fluid pressure.

735,311. ATTACHMENT FOR PRINTING TELEGRAPHS OR OTHER SWIFT DELIVERING APPARATUS; C. M. Stiner, New York, N. Y. App. filed Feb. 11, 1901. A cabinet attached to a stock ticker and containing mechanism which receives the printed tape, and arranges it in regularly succeeding sections, a large number of which are exposed to view.

735,317. SNAP SWITCH OPERATING MECHANISM; W. C. Tregoning, Hartford, Conn. App. filed April 23, 1903. Details.

735,324. ELECTRIC PROTECTIVE SYSTEM; J. Weatherby, Jr., New Cumberland, Pa. App. filed March 24, 1903. Details.

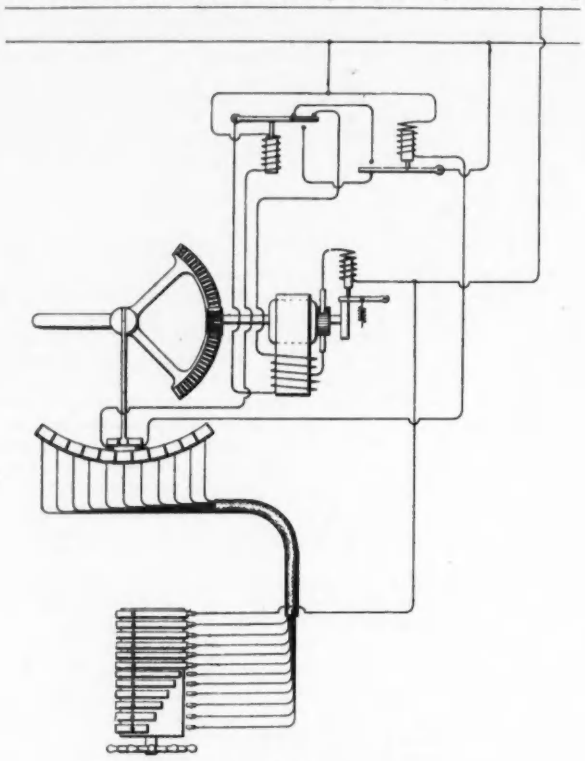
735,340. SURFACE CONTACT ELECTRIC RAILWAY SYSTEM; W. M. Brown, Johnstown, Pa. App. filed Dec. 18, 1902. In case the magnet on the car picks up iron objects from the roadway, they are removed by a constantly energized and stronger magnet, located in the roadway immediately ahead of a crossing, of branch track, so that short circuits cannot occur.

735,352. SYSTEM OF ELECTRICAL DISTRIBUTION; G. S. Dunn, East Orange, N. J. App. filed June 18, 1903. In connection with a multivoltage four wire system, a switch is used by means of which a regular graduation of voltages can be impressed upon a motor.

735,363. ELECTRIC SWITCH; H. Gilmore, Boston, Mass. App. filed April 18, 1902. Details.

735,375. COMMUTATOR BRUSH HOLDER; C. H. Hines, Buffalo, N. Y. App. filed Jan. 30, 1903. The brush holder carries a scale by which the pressure exerted by the brush upon the commutator can be ascertained.

735,384. CHARGING SWITCH; M. R. Hutchison, Norwood, N. J. App. filed Nov. 26, 1902. An electro magnet and a permanent magnet co-



735,550.—Electric Steering Gear.

operate in action upon a switch to determine the polarity of current flowing to the battery.

735,386. MEANS FOR CONTROLLING ELECTRIC MOTORS; J. D. Ihlder, Yonkers, N. Y. App. filed April 19, 1899. A push button control system for alternating current motors driving elevators.

735,406. SYSTEM OF ELECTRICAL DISTRIBUTION AND TRANSFORMING. C. M. Palmer, Fon du Lac, Wis. App. filed Dec. 13, 1899. Translating circuits including an inductive resistance are shunted across the terminals of storage batteries connected in a main circuit on which pulsating currents flow.

735,416. ELECTRIC SIGNALING APPARATUS; H. W. Souder, Tamaqua, Pa. App. filed March 25, 1902. Consists of a system capable of being operated by a number of cars following one another in the same direction, affording information to each motorman of the fact that one or more cars are ahead of him.

735,417. ELECTRIC SIGNALING APPARATUS; H. W. Souder, Tamaqua, Pa. App. filed Aug. 30, 1902. A railway block system in which the distant signal is first set and if the circuit is thus complete through it, the home signal follows, thus indicating that both signals are in working order.

735,419. TROLLEY CONTACT; H. W. Souder, Tamaqua, Pa. App. filed Sept. 25, 1902. A comb-like structure supported above the wire and adapted to be touched by the rim of the trolley wheel.

735,438. METHOD OF CONTROLLING ALTERNATING CURRENT MOTORS; Albert H. Armstrong, Schenectady, N. Y. App. filed March 2, 1899. In operating tandem induction motors, the primary windings of the first of the two motors is connected in delta.

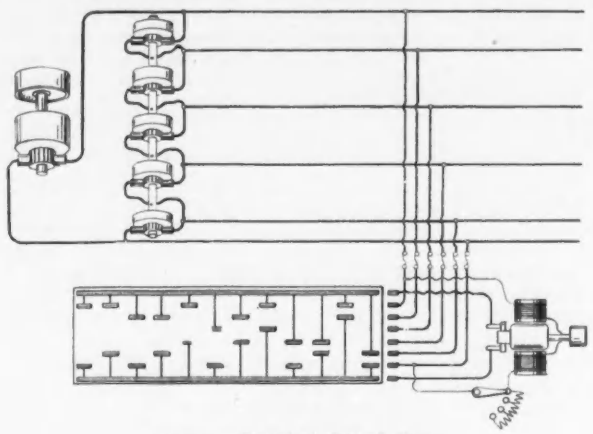
735,452. ELECTRIC SWITCH; W. L. Bliss, Brooklyn, N. Y. App. filed Feb. 26, 1902. A pneumatic switch comprising a cylinder, a piston-rod projecting through the head of the cylinder carrying a bridging contact, the latter being covered by a protecting cap.

735,464. ELECTROLYTIC DIAPHRAGM; Eugene A. Byrnes, Washington, D. C. App. filed May 12, 1903. (See page 257.)

735,508. MULTIPLEX TELEGRAPHY; P. E. Heina, Paris, France. App. filed Jan. 22, 1902. The application of a differential triple-wire transformer for transmitting duplex signals in the various systems of multiplex telegraphy, where pulsating currents are employed, and in connection with two induction coils the primary wires of which are connected with the transmitting apparatus.

735,511. ANNUNCIATOR; E. M. Hewlett, Schenectady, N. Y. App. filed Aug. 3, 1900. The banner has an intermediate position to which it can be set to open an alarm circuit normally closed by the banner at the open position.

735,531. SWITCH FOR SYSTEMS OF REMOTE CONTROL; O. M. Lacey, Hanford, Cal. App. filed Oct. 16, 1902. Details.



735,352.—Electrical Distribution.

735,541. ELECTRIC AUTOMATIC GAS LIGHTER AND SHUTOFF; H. J. Lyons, Guyandotte, W. Va. App. filed Dec. 19, 1902. Comprises a bellows to be connected with a gas main and gas burner, with means controllable at will for inflating the bellows with gas and electrical apparatus connected with the bellows for automatically lighting the burners, when the bellows is inflated.

735,550. ELECTRIC STEERING GEAR; W. L. Merrill, Schenectady, N. Y. App. filed April 18, 1903. Brushes geared to the motor are adapted to move over a series of contacts and means are provided for charging a greater or less number of the contacts, and other means for varying the motor connections, which are dependent upon the position of the brushes.

735,577. HANDLE FOR ELECTRIC SWITCHES; C. G. Perkins, Hartford, Conn. App. filed June 10, 1903. Details of construction of a handle having a yielding connection with the rotary switch-spindle.

735,581. THERAPEUTICAL APPARATUS; A. Pollacsek and B. Beer, Vienna, Austria-Hungary. App. filed Oct. 20, 1902. A metal cap to be applied to the head, and to which is attached an electric coil through which alternating currents are directed for the purpose of exciting the scalp.

735,584. SURFACE CONTACT RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed April 23, 1902. A positive and a negative feeder leading from the source of current and a ground connection at a single point located at the end of the negative feeder farthest from the source.

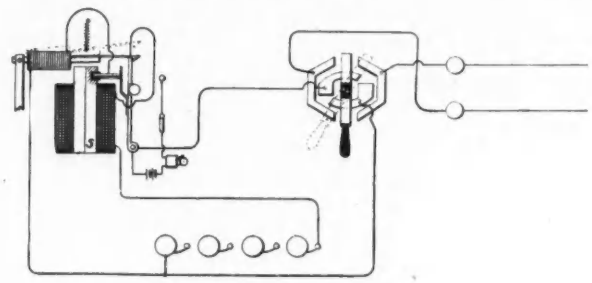
735,611. SPHEROIDAL STRAIN; L. Steinberger, New York, N. Y. App. filed Jan. 14, 1903. Two interlocking parts electrically insulated and surrounded by a sphere of insulation.

735,612. SINGLE LINK STRAIN; L. Steinberger, New York, N. Y. App. filed Jan. 29, 1903. One member consists of an eye, and the other of a tube passing through the eye with insulation inserted between the metallic surfaces.

735,613. SUSPENSION FIXTURE; L. Steinberger, New York, N. Y. App. filed Feb. 2, 1903. A fixture performing the function of a turn-buckle, of a strain and of a hanger for span wire clips.

735,621. ELECTROSTATIC MOTOR; Elihu Thomson, Swampscott, Mass. App. filed March 25, 1903. There are two elements analogous to the potential and current coils of a wattmeter. One is stationary and connected across the mains, and consists of two opposing metallic plates facing a hard-rubber drum; on the inside of the drum are strips connected with a commutator on which bear two brushes in series with the supply circuit. The drum will move if the brushes on the strips in an angularly displaced position with respect to the field plates.

735,631. INSULATED JOINT; G. A. Weber, New York, N. Y. App. filed March 4, 1903. A joint for railway rails in which there are two insulated breaks in the rail, instead of one, as usual.



735,384.—Charging Switch.

735,639. AXLE LOCKING DEVICE FOR TROLLEY HARPS; A. J. Wiggin, Kennebunk, Me. App. filed Feb. 7, 1902. A spring plate grasping the squared end of the trolley axle.

735,651. APPARATUS FOR CONTROLLING ALTERNATING CURRENT MOTORS; Albert H. Armstrong, Schenectady, N. Y. App. filed March 2, 1899. See note following patent No. 735,438.

735,686. METHOD OF OPERATING ALTERNATING CURRENT INDUCTION MOTORS; Arnaldo P. Zani, Berlin, Germany. App. filed Aug. 11, 1899. See note following patent No. 735,190.

735,672. TROLLEY RETRIEVER; A. W. Knutson, Canton, Ohio. App. filed Jan. 17, 1903. Details of a spring drum, and pawl and ratchet mechanism.

735,676. SYNCHRONIZER; D. J. Richards, New Baltimore, Mich. App. filed Feb. 24, 1903. Details of mechanism for automatically throwing machines together when they arrive at synchronism.

735,687. ELECTROTHERAPEUTIC APPARATUS; S. B. Zink, Portsmouth, Va. App. filed June 17, 1903. A bed-like structure having electrodes located at various points for easy application to the various parts of the body.